LAND MANAGEMENT HANDBOOK

59

Management Strategy for Mule Deer Winter Ranges in the Cariboo-Chilcotin Part 1b: Management Plan for Transition and Deep Snowpack Zones

2006

BRITISH COLUMBIA

Ministry of Forests and Range
Forest Science Program

106-06671/

Management Strategy for Mule Deer Winter Ranges in the Cariboo-Chilcotin Part 1b: Management Plan for Transition and Deep Snowpack Zones

Rick Dawson, Harold Armleder, Becky Bings, and Darcy Peel

BRITISH COLUMBIA

Ministry of Forests and Range
Forest Science Program

The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the Government of British Columbia of any product or service to the exclusion of any others that may also be suitable. Contents of this report are presented as information only. Funding assistance does not imply endorsement of any statements or information contained herein by the Government of British Columbia. Uniform Resource Locators (URLs), addresses, and contact information contained in this document are current at the time of printing unless otherwise noted.

Library and Archives Canada Cataloguing in Publication Data
Main entry under title:
Management strategy for mule deer winter ranges in the Cariboo-Chilcotin. Part 1b, Management plan for transition and deep snowpack zones

(Land management handbook, ISSN 0229-1622 ; 59)

"Cariboo-Chilcotin land use plan."–Cover.
"Prepared for B.C. Ministry of Forests and Range, Research Branch."–P.
Includes bibliographical references: p.
ISBN 0-7726-5463-8

1. Mule deer - Habitat - British Columbia - Cariboo Region. 2. Forest management - British Columbia - Cariboo Region. 3. Mule deer - Effect of forest management on - British Columbia - Cariboo Region. I. Dawson, R. J. (Rick James), 1954- . II. British Columbia. Forest Science Program. III. British Columbia. Ministry of Forests and Range. Research Branch. IV. Title: Cariboo-Chilcotin land use plan. V. Series.

QL737.U55M36 2006 333.95'9653'097117 C2005-960242-2

Citation
Dawson, R.J., H.M. Armleder, B.A. Bings, and D.E. Peel. 2006. Management strategy for mule deer winter ranges in the Cariboo-Chilcotin – part 1b: management plan for transition and deep snowpack zones. B.C. Min. For. Range, Res. Br., Victoria, B.C. Land Manage. Handb. 59. http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh59.htm

Prepared by
Rick Dawson
B.C. Ministry of Agriculture and Lands
Integrated Land Mangement Bureau
Williams Lake, B.C

Harold Armleder
B.C. Ministry of Forests and Range
Williams Lake, B.C.

Becky Bings
B.C. Ministry of Environment
Williams Lake, B.C.

Darcy Peel
B.C. Ministry of Agriculture and Lands
Integrated Land Mangement Bureau
Williams Lake, B.C

Prepared for
B.C. Ministry of Forests and Range
Research Branch
Victoria, B.C.

©2006 Province of British Columbia

Copies of this report can be obtained from:
Government Publications Services
PO Box 9452 Stn Prov Govt
Victoria, B.C. V8W 9V7
1-800-663-6105 (toll free)
http://www.publications.gov.bc.ca/

For more information on Forest Science Program publications, visit our Web site at
http://www.for.gov.bc.ca/scripts/hfd/pubs/hfdcatalog/index.asp

PREFACE

The four components of the Management Strategy for Mule Deer Winter Ranges in the Cariboo-Chilcotin are:

Part 1a: *Management Plan for Shallow and Moderate Snowpack Zones*

Part 1b: *Management Plan for Transition and Deep Snowpack Zones*

Part 2: *Long-term Objectives Maps for Individual Winter Ranges*

Part 3: *Transition-period Harvest Opportunity Plans for Individual Winter Ranges*

This document is Part 1b: *Management Plan for Transition and Deep Snowpack Zones*. This report, along with Part 2, *Long-term Objectives Maps for Individual Winter Ranges*, is the complete package of government direction for forest management within mule deer habitat in the transition and deep snowpack zones in the Cariboo-Chilcotin region. It was prepared for the Cariboo Managers' Committee of the Provincial Government of British Columbia.

EXECUTIVE SUMMARY

This document is Part 1b of a set of information required for planning timber harvesting on individual mule deer winter ranges in the transition and deep snowpack zones within the Cariboo-Chilcotin, British Columbia. This plan sets out stand-level objectives and strategies for these winter ranges. The second set of information, the long-term spatial objectives maps for each winter range, is briefly described here but will be accessed through a Web site documented in this report.

This plan provides objectives and strategies for managing winter range habitat, including:

- road access planning and management;
- stand age structure for the stand mosaic created by group selection;
- tree species composition for winter range stands;
- size and distribution of harvest openings within the context of a group selection silviculture system; and
- spatial planning of group selection harvest treatments.

A checklist is provided to assist those who are preparing Forest Stewardship Plans (FSPs) and silviculture prescriptions on winter ranges and for those who will implement and monitor winter range management activities. This section highlights the need to carefully plan, implement, and monitor all management activities on mule deer winter range.

Appendices provide additional background information, including the following:

- definition of snowpack zones;
- definitions of specialized terms used in the report;
- discussion of the relationship of the objectives in this plan to the management of biodiversity and selected wildlife species;
- a background discussion of the silvicultural practices designed for winter range management in these snowpack zones;
- a background discussion of integrated approaches to some insect and disease issues on mule deer winter range; and
- a brief history of mule deer winter range management and research in the Cariboo-Chilcotin.

This plan has been developed following years of research and consultation. The objectives and strategies presented are compatible with the *Cariboo-Chilcotin Land Use Plan* (CCLUP) and forest management directions, including the CCLUP *Integration Report* (1998) and the *Identified Wildlife Management Strategy* (1999). The winter ranges boundaries were legally designated in 2004 under *Government Action Regulations*, and *General Wildlife Measures* for mule deer winter ranges are being prepared based on this report.

ACKNOWLEDGEMENTS

This management strategy is the culmination of many years of research and planning starting in the late 1970s. Numerous biologists, foresters, and resource managers from the Ministry of Environment and the Ministry of Forests and Range have played a part in developing this important strategy for sound management of mule deer winter habitat in the Cariboo-Chilcotin.

This management plan was prepared by the CCLUP Mule Deer Winter Range Strategy Committee. Members of this committee include Harold Armleder, Becky Bings, Rick Dawson, and Darcy Peel. The research efforts of Harold Armleder, Rick Dawson, Michaela Waterhouse, Rob Thomson, and numerous field staff provided the basis for many of the strategy recommendations.

The Mule Deer Working Group from the Cariboo Lumber Manufacturers' Association provided early input to the management strategy. Ken Day and Mircea Rau, from the University of British Columbia (UBC) Research Forest, have provided thoughtful input throughout the development of the strategy. Chris Nowotny, Nowotny Biological Services, provided useful review comments and John Youds from the Ministry of Environment reviewed the final draft. Marty Beets, also from the Ministry of Environment, provided early impetus to develop innovative solutions to the mule deer winter range issues.

The Mule Deer Winter Range Strategy Committee gratefully acknowledges the input of many other people who have helped and provided input in developing this mule deer winter range strategy.

CONTENTS

Preface ... iii

Executive Summary ... iii

Acknowledgements ... iv

1 Introduction ... 1

2 Winter Range Management Objectives ... 3
2.1 Long-term Spatial Objectives ... 3
2.2 Access Objectives ... 5
2.2.1 Strategies for meeting access objectives ... 5
2.3 Stand-level Objectives ... 7
2.3.1 Objective 1: Age structure ... 8
2.3.2 Objective 2: Species composition ... 10
2.3.3 Objective 3: Opening size ... 13
2.3.4 Objective 4: Location of openings, leave areas, and access ... 14
2.3.5 Objectives for individual harvest entries ... 16
2.3.6 Timing and sequence of management actions ... 20

3 Planning Forest Harvests To Meet Winter Range Objectives ... 20
3.1 Basic Steps for Planning a Cutblock on Winter Range ... 20
3.2 Checklist for Forest Harvest Planning ... 21

APPENDICES
1 Snowpack zones in the Cariboo-Chilcotin ... 22
2 Biodiversity and special wildlife species management on winter ranges ... 22
3 Mule deer winter range management and research in the Cariboo-Chilcotin ... 24
4 Use of group selection on moderate snowpack winter ranges ... 26
5 Glossary ... 27
6 Applicable silvicultural systems and treatments ... 28
7 Forest health management on winter range ... 33

Literature Cited ... 36

TABLES
1 Target-age distributions for individual cutblocks for each of the three stand structure habitat class objectives ... 8
2 Cutting cycle and percentage of harvest for group selection systems in three stand structure habitat class objectives ... 9
3 Objectives for group selection opening size in the transition and deep snowpack zones ... 13
4 Harvest Opportunity Types for mule deer winter ranges in the transition and deep snowpack zones within the Cariboo-Chilcotin ... 17

5 Timing and sequence of management actions for various stand types and conditions 20
A1.1 Definition of snowpack zones for mule deer winter range management in the Cariboo-Chilcotin 22
A6.1 Relative quality of habitat attributes as a function of Douglas-fir patch age in transition and deep snowpack winter range stands 29

FIGURES

1 Management strategy for mule deer winter ranges in the Cariboo-Chilcotin 2
2 Example of long-term objectives map 4
3 Topographic features especially important on mule deer winter ranges 6
4 Terminology used to refer to various areas managed within a winter range 7
5 Age cohorts for "low," "moderate," and "high" stand structure habitat classes 9
6 Example use of shelterwood within a group selection system for frost-prone micro-sites 11
7 Example of a stand with >40% lodgepole pine on a frost-prone site 12
8 Location of skid trails in relation to ridge or topographic break 15
A6.1 Schematic representation of a stand managed with different stand structure class objectives at middle of cutting cycle 29
A6.2 Thinning-from-below in Douglas-fir–dominated stands with a dense pole layer 32

The *Management Strategy for Mule Deer Winter Ranges in the Cariboo-Chilcotin* (see Figure 1) provides habitat management direction at stand and landscape scales across four snowpack zones for all of the deer winter ranges in the Cariboo-Chilcotin. The strategy is designed to meet the direction of the *Cariboo-Chilcotin Land Use Plan (CCLUP) Integration Report* (1998), which integrates both timber and mule deer habitat targets. The shaded portion of the box shows the main elements of the strategy that are covered by the document you are now reading.

This management plan is one of two parts that provide government direction required for managing mule deer winter range habitat in transition and deep snowpack zones in the Cariboo-Chilcotin, British Columbia. The two parts are:

1b. *Management Plan for Transition and Deep Snowpack Zones* (this document)
This plan describes the management objectives for mule deer winter ranges within the transition and deep snowpack zones in the Cariboo-Chilcotin Region.

2. *Long-term Objectives Maps for Individual Winter Ranges*
These maps show the spatial location of all winter range habitat objectives on each individual winter range.

Winter ranges in the shallow and moderate snowpack zones have a separate management plan (Part 1a) for stand-level guidance and also use a "Transition Period Harvest Opportunity Plan" to describe harvest opportunities available before 2026. In the transition and deep snowpack zones, all harvest opportunities are available immediately.

The transition and deep snowpack zones include approximately one-quarter of the identified mule deer winter range area within the Cariboo-Chilcotin. Most occur in mule deer range areas that are associated with the warm aspect of valley systems at moderate elevations.

The *Management Strategy for Mule Deer Winter Ranges in the Cariboo-Chilcotin* is designed to guide forest harvest planning to maintain or, where required, to restore winter range habitat suitability. In accordance with the *CCLUP Integration Report* (1998) direction, this strategy provides increased timber harvesting access to the winter range in the short and long term. Maintaining habitat values with this increased level of access will require concerted effort and a high level of accountability from foresters developing forest stewardship plans and site prescriptions on winter ranges. Even if formal site plans are not submitted for approval, it is critical that the forester planning each cutblock on winter range develops plans that meet the objectives in this management plan. It is also important for the forester to clearly document stand structure prescriptions that show how each block will be managed over time. In addition, those responsible for implementing the site plans will need to carefully supervise the harvesting operations to ensure that they are properly implemented on the ground. Government agencies will need to carefully monitor the implementation of this management plan to ensure that habitat values are not eroded, or put at risk.

This management plan is one of two parts that provide government direction required to manage mule deer winter range habitat in the transition and deep snowpack zones in the Cariboo-Chilcotin.

Figure 1 summarizes the two-part package of direction available for managing mule deer winter ranges in the Cariboo-Chilcotin. The shaded box highlights the main parts of this report: *Management Plan for Transition and Deep Snowpack Zones.*

Management Strategy for Mule Deer Winter Ranges in the Cariboo-Chilcotin

Part 1: **Management Plans for Specific Snowpack Zones**

Part 1a: **Management Plan for Shallow and Moderate Snowpack Zones**

- Provides stand-level objectives and strategies for winter ranges in the shallow and moderate snowpack zones
- Available from Ministry of Environment Web site (Cariboo Region)

Part 1b: **Management Plan for Transition and Deep Snowpack Zones**

- Management Objectives and Strategies
  - Long-term spatial objectives
  - Access objectives
  - Stand-level objectives
    - Overall objectives
    - Objectives for individual harvest entries
    - Timing and sequence of harvest entries
- Planning and Forest Harvesting
  - Planning steps
  - Planning checklist

Part 2: **Long-term Objectives Maps**

- Show spatial delineation of long-term objectives for Stand Structure Habitat Classes over whole winter ranges and show major topographic buffers
- Available on Ministry of Environment Web site (Cariboo Region)

Part 3: **Transition Period Harvest Opportunity Plan**

- Provides direction on available harvest opportunities from now until 2026 for shallow and moderate snowpack zone winter ranges. Note that there are no transition period harvesting restrictions on winter range habitat classified as Transition and Deep Snowpack Zone.
- Available on Ministry of Environment Web site (Cariboo Region)
  <http://wlapwww.gov.bc.ca/car/env_stewardship/wildlife/ecosystems/mdwr_strat/mgmtplan.html>*

FIGURE 1 *Management strategy for mule deer winter ranges in the Cariboo-Chilcotin.*

The *Management Strategy for Mule Deer Winter Ranges in the Cariboo-Chilcotin* is the culmination of the sustained research and planning efforts of many people over the past 25 years. Appendix 3 of this document summarizes the major milestones of that work. The *Cariboo-Chilcotin Land Use Plan Integration Report* mandated the creation of the Cariboo Regional Mule Deer Winter Range Committee to develop mule deer winter range plans and objectives. The committee is made up of resource management experts from the Ministry of Forests and Range, the Ministry of Agriculture and Lands, and the Ministry of Environment. Two of the committee members were principal researchers in an extensive research program to investigate mule deer winter ecology and management options.

Those familiar with the *Mule Deer Handbook* (Armleder et al. 1986), the *Mule Deer Strategy* (1996) prepared for the CCLUP, and the *CCLUP Integration Report* (1998) will find that this management plan refines the direction given by these documents. The plan is meant to be used by forest managers proposing and planning development on winter ranges, as well as those who regulate and monitor development. Different parts of the plan may be more relevant to different types of users. The following summary is meant to help guide users to the parts of the plan that will be most useful to them.

* This URL address is current as of January 2006, after this time frame, it is our understanding a consistent pointer will direct you to the new URL address.

In this report, Section 2 "Winter Range Management Objectives," describes three types of winter range management objectives. The first type, "Long-term Spatial Objectives," provides management direction at the broadest scale through spatial delineation of stand structure habitat class objectives (high, moderate, and low) over entire winter ranges. These long-term spatial objectives are presented on individual maps for each winter range and can be obtained in electronic form from the Ministry of Environment Web site. The second type, "Access Objectives," provides direction on how to plan and manage access on winter ranges to reduce potential negative impacts on mule deer. The third type, "Stand-level Objectives" provides management direction at the stand and cutblock level. The stand-level objectives include "Overall stand-level objectives" as well as "Objectives for individual harvest entries."

Section 3, "Planning Forest Harvests To Meet Winter Range Objectives," provides a simplified list of steps for those planning harvesting on winter ranges and a more detailed checklist of critical direction for planning of winter range harvest blocks. As well as aiding forest industry planners, the checklist will provide general guidance for monitoring management activities carried out within winter ranges.

The Appendices provide more detailed information for users who want to gain a better understanding of the direction provided in the main body of this plan. **Both Appendix 1 and 4 provide information that is critical to those implementing or monitoring management actions on the ground.** Appendix 1 defines the location of the four snowpack zones based on biogeoclimatic zones and subzones. Appendix 4 lists winter ranges where the stand-level guidance from this plan should be used on the north-facing portions of mule deer winter ranges in the moderate snowpack zone. Appendix 5 provides a glossary that defines some of the more specific terms used in this document.

2 WINTER RANGE MANAGEMENT OBJECTIVES

The overall winter range strategy contains three types of objectives:

- Long-term Spatial Objectives
- Access Objectives
- Stand-level Objectives

Throughout this section, objectives are enclosed in shaded boxes.

2.1 Long-term Spatial Objectives

A long-term objectives map has been developed for each winter range. These maps provide management direction at the broadest scale through spatial delineation of stand structure habitat class objectives (high, moderate, and low) over entire winter ranges. The maps also show the location of topographic buffers, woodlots, private land, and habitat management zones. Completed long-term objectives maps can be found on the following Web site:

<http://wlapwww.gov.bc.ca/car/env_stewardship/wildlife/ecosystems/mdwr_strat/mgmtplan.html>*

An example of one of these maps is shown as Figure 2. The proportions of winter range managed for low, moderate, and high mule deer stand structure habitat classes depends on which snowpack zone or zones the winter range is located on, as described in the *Mule Deer Handbook*.

The long-term objectives map for each winter range provides direction on where to manage for each of three stand structure habitat classes.

On some winter ranges, the Mule Deer Winter Range Committee has modified these proportions to better address local conditions. However, the amount of winter range target (i.e., high and moderate stand structure habitat provided by the CCLUP) was not exceeded over a Timber Supply Area.

Distribution of these stand structure habitat class objectives will vary within different parts of each winter range to address the function that each winter range part provides for deer, the timber tenures in the zone, and the ecological capability to produce specific habitat types. For example, a low-elevation area with a predominantly warm aspect may receive very high deer use in deep snow conditions. Therefore, the objective for this type of area will usually specify mostly high stand structure class, provided site conditions are capable of producing this stand structure class.

* This URL address is current as of January 2006, after this time frame, it is our understanding a consistent pointer will direct you to the new URL address.

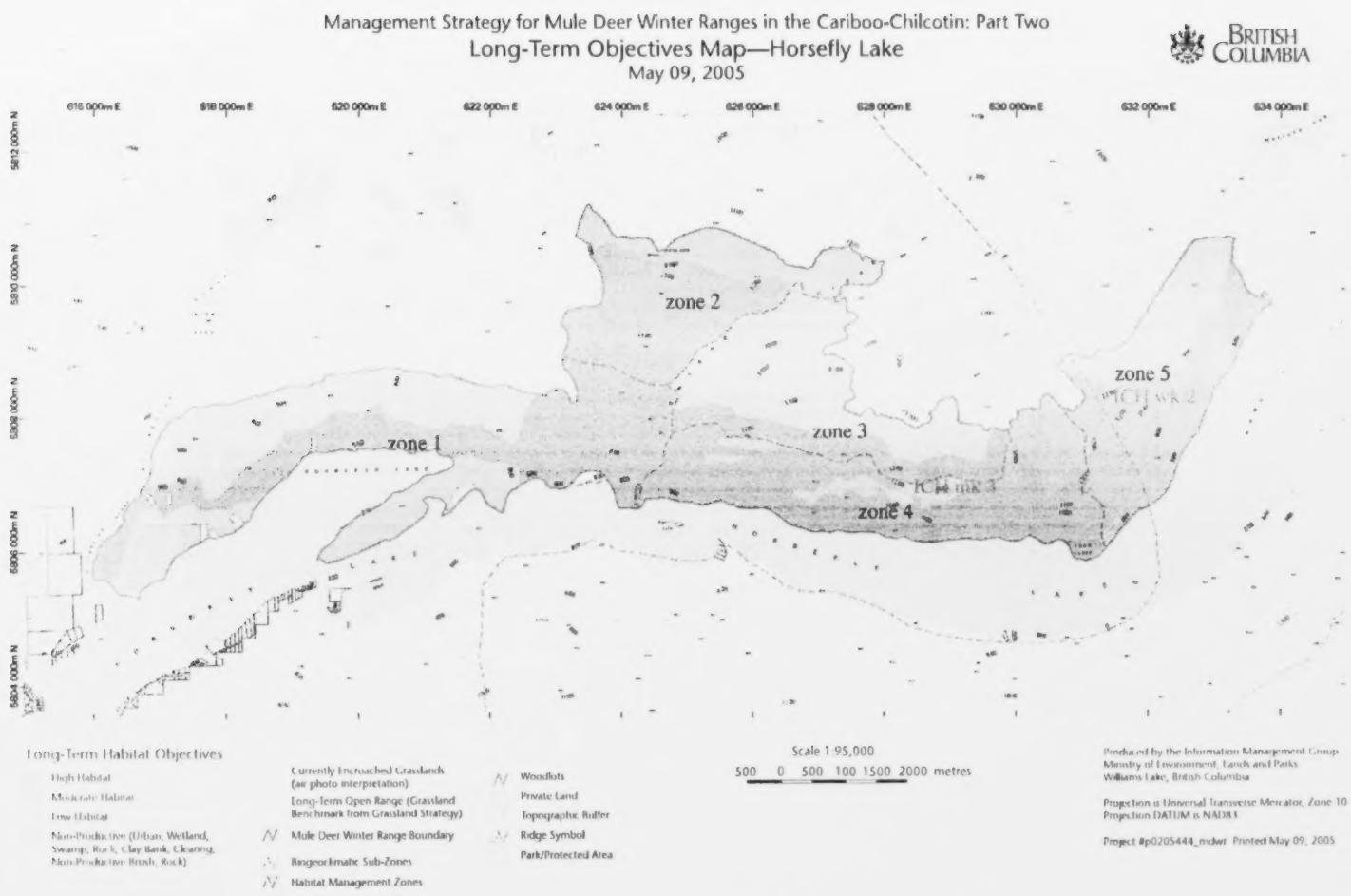


FIGURE 2 *Example of long-term objectives map.*

Alternatively, another area with a higher capability to produce shrub forage may be used mostly in the early winter when snow is shallower. This type of area may have an objective to maintain a more moderate stand structure habitat class.

An individual winter range may include portions in both the transition snowpack zone and in the moderate snowpack zone. Stand-level direction from ***Part 1a: Management Plan for Shallow and Moderate Snowpack Zones*** should be followed for the moderate snowpack portion of these winter ranges.

Each winter range is divided into Habitat Management Zones. They may be used on some winter ranges to identify areas where specific management recommendations should be applied. Existing woodlots are always put into their own Habitat Management Zone.

2.2 Access Objectives

Good access management on winter range can reduce deer mortality and minimize energy losses. Vehicle traffic has the potential effect of displacing deer from adjacent habitat and increasing levels of harassment. Ploughed roads make travel easier for predators in deeper snow conditions. More roads increase legal and illegal hunting success. Roads are especially problematic in key habitats such as areas adjacent to topographic breaks and ridges. Motorized off-road recreation (e.g., snowmobiles, all-terrain vehicles) can also lead to harassment and displacement of deer on winter ranges.

Deer are in an energy deficit situation in winter, therefore any extra energy expenditures caused by poor access management have cumulative negative effects on their health and condition.

Buffers for **major** topographic features are drawn on long-term objectives maps while **minor** topographic features must be defined on the ground by those implementing forestry management treatments or building roads (Figure 3).

2.2.1 Strategies for meeting access objectives

Strategies for managing access on winter ranges include:

- minimizing the number of roads that are ploughed in the winter;
- minimizing the number of roads open to vehicle traffic at any time (ideally, deactivate roads to prevent 4-wheel drive access if not needed for harvesting or silvicultural activities for 2 years or more);
- completely deactivating old roads in topographic buffers as much as possible; and
- planning unlogged and unspaced buffers along roads to reduce sight distances and harassment (the width of these buffers can be flexible—the objective is to provide a visual screen).

Access objectives:

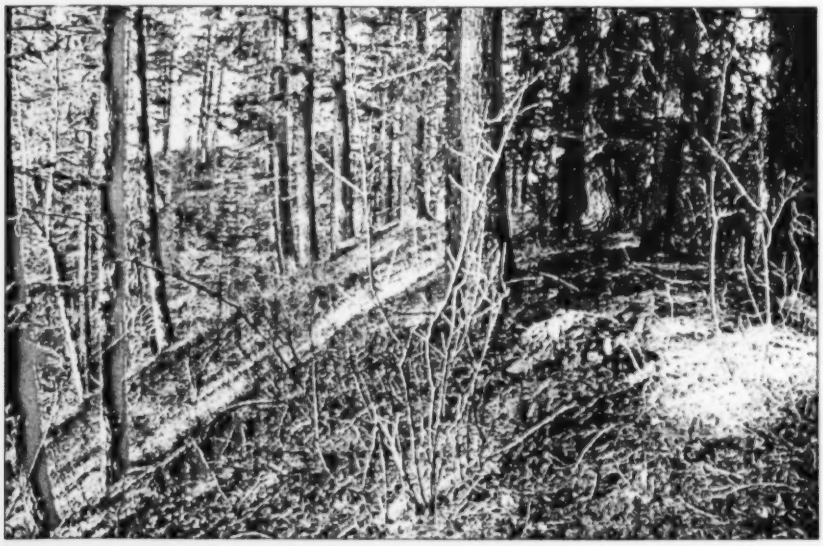
1. Do not construct roads or landings within:
   a. topographic buffers identified along major topographic features on long-term objectives maps, or
   b. 100 m of minor ridges* or minor topographic breaks* identified in the field.

Note: Perpendicular road crossings that are absolutely required to access otherwise isolated timber are an exception to access objectives 1a and 1b.

2. Minimize road and landing areas for all harvest blocks.
3. Do not build roads within Old Growth Management Areas (OGMAs) unless no other viable option is available.
4. Plan and manage roads within winter ranges to minimize motorized access during winter and to minimize disturbance of deer.

* *Topographic breaks and ridges are defined as features requiring special management where the slope is greater than 15% when measured from the apex of the feature to a point 15 m perpendicular to the feature or to the nearest gully bottom if this is less than 15 m away. Ridges have a slope >15% on both sides while topographic breaks have a slope of >15% on only one side.*

A



B

FIGURE 3 *Topographic features especially important on mule deer winter ranges.*
A) Major ridges and topographic breaks like this would usually require a road-free buffer of 100–300 m as indicated on long-term objectives maps.
B) Minor topographic features like this one may not be indicated on long-term objectives maps, but are still very important habitats for deer and need to be identified for special consideration during forestry and road-building operations.

2.3 Stand-level Objectives

This section includes three parts. The first, Sections 2.3.1 to 2.3.4, provides overall objectives and strategies. Objectives are set for the following stand characteristics within the context of stand management using a group selection silviculture system:

- age structure;
- tree species composition;
- opening size; and
- spatial distribution of openings and leave areas.

Some of these objectives are very long-term and will not be achieved until 100 years or more in the future. However, knowing the future desired condition provides critical overall guidance and direction for all current management activities. Note that the long-term objective for all stands, with the exception of those on subhygric sites unsuitable for Douglas-fir management, is to create and maintain an uneven-aged stand mosaic of small even-aged patches through group selection. In some stand types, group selection may begin at the first harvest pass, while in others, different harvest treatments may be appropriate on the first pass.

Appendix 6 includes background information for readers interested in a description of group selection silviculture systems and their application to mule deer winter range management. It also provides information on applying shelterwood and thinning-from-below silviculture systems on transition and deep snowpack winter range.

Section 2.3.5 provides measurable objectives and strategies for individual treatments (called "Harvest Opportunity Types") that form the steps in the management sequence described in Section 2.3.6. The objectives for each stand type and stand structure habitat class are designed to integrate deer habitat requirements with workable silviculture and harvesting practices for these forest types.

Section 2.3.6 provides guidance on the sequence of management steps required to deal with various stand conditions and to move various stand structures towards the desired long-term condition while maintaining adequate habitat quality. These steps and their sequences will be different for different initial stand structures and will vary between stands with different long-term objectives. The objectives for each treatment, as well as the timing between treatments, are both vital to moving efficiently toward the desired long-term condition and for maintaining reasonable habitat quality along the way. These treatment and timing objectives provide measurable elements to be applied and monitored under a results-based management system.

Note that these stand-level objectives apply to all of the transition and deep snowpack zones as well as those portions of the moderate snowpack zone described in Appendix 4.

The next four sections are devoted to the overall stand objectives. In each subsection, the objective is first presented in a shaded box along with additional comments and clarifications. Strategies for meeting the objectives are then presented. For clarity, Figure 4 depicts the terminology used to refer to various areas managed within a winter range.

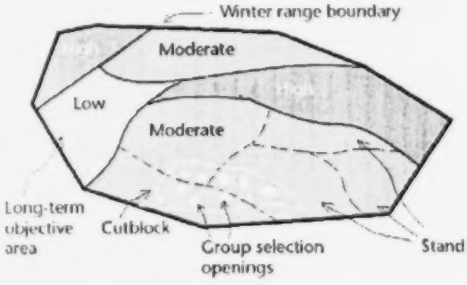


FIGURE 4 *Terminology used to refer to various areas managed within a winter range. Definitions of how the terms "stand," "cutblock," and "group selection opening" are used in this report are included in the Glossary (see Appendix 5).*

2.3 Stand-level Objectives

This section includes three parts. The first, Sections 2.3.1 to 2.3.4, provides overall objectives and strategies. Objectives are set for the following stand characteristics within the context of stand management using a group selection silviculture system:

- age structure;
- tree species composition;
- opening size; and
- spatial distribution of openings and leave areas.

Some of these objectives are very long-term and will not be achieved until 100 years or more in the future. However, knowing the future desired condition provides critical overall guidance and direction for all current management activities. Note that the long-term objective for all stands, with the exception of those on subhygric sites unsuitable for Douglas-fir management, is to create and maintain an uneven-aged stand mosaic of small even-aged patches through group selection. In some stand types, group selection may begin at the first harvest pass, while in others, different harvest treatments may be appropriate on the first pass.

Appendix 6 includes background information for readers interested in a description of group selection silviculture systems and their application to mule deer winter range management. It also provides information on applying shelterwood and thinning-from-below silviculture systems on transition and deep snowpack winter range.

Section 2.3.5 provides measurable objectives and strategies for individual treatments (called "Harvest Opportunity Types") that form the steps in the management sequence described in Section 2.3.6. The objectives for each stand type and stand structure habitat class are designed to integrate deer habitat requirements with workable silviculture and harvesting practices for these forest types.

Section 2.3.6 provides guidance on the sequence of management steps required to deal with various stand conditions and to move various stand structures towards the desired long-term condition while maintaining adequate habitat quality. These steps and their sequences will be different for different initial stand structures and will vary between stands with different long-term objectives. The objectives for each treatment, as well as the timing between treatments, are both vital to moving efficiently toward the desired long-term condition and for maintaining reasonable habitat quality along the way. These treatment and timing objectives provide measurable elements to be applied and monitored under a results-based management system.

Note that these stand-level objectives apply to all of the transition and deep snowpack zones as well as those portions of the moderate snowpack zone described in Appendix 4.

The next four sections are devoted to the overall stand objectives. In each subsection, the objective is first presented in a shaded box along with additional comments and clarifications. Strategies for meeting the objectives are then presented. For clarity, Figure 4 depicts the terminology used to refer to various areas managed within a winter range.

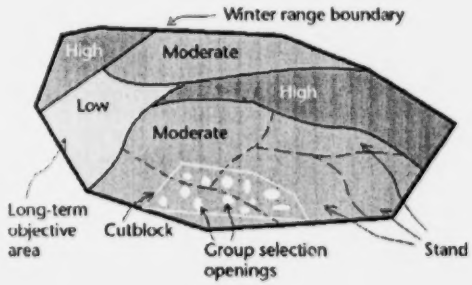


FIGURE 4 *Terminology used to refer to various areas managed within a winter range. Definitions of how the terms "stand," "cutblock," and "group selection opening" are used in this report are included in the Glossary (see Appendix 5).*

2.3.1 Objective 1: Age structure

Group selection harvest treatments for each block must be planned to meet the age distribution set out in Table 1, after a full rotation. Harvest treatments must not result in the 0–40 year age component covering a greater area than the percentage shown in the 0–40 column below.

TABLE 1 *Target-age distributions for individual cutblocks for each of the three stand structure habitat class objectives. The table shows long-term targets for percentage of area in each age class, within a cutblock, after a full set of cutting cycles. Age structure of the block is controlled by the cutting cycle and the area harvested per pass. Note that skid trail area is included in the percentage-area targets for the 0–40 year age class.*

Stand structure habitat class objective	Age-class categories (years)				
	0–40	41–80	81–120[a]	121–160[a]	161–200+
Low	33%	33%	33%	NA	NA
Moderate	25%	25%	25%	25%	NA
High	20%	20%	20%	20%	20%

a The upper limit of the oldest Age Class Category for each Stand Structure Habitat Class can be exceeded.

Comments:

- The age structure objective is designed to guide the long-term stand structure development of individual cutblocks that are managed using a group selection silviculture system.
- The table above provides the desired age structures after a complete set of group selection cutting cycles has resulted in harvesting all parts of the cutblock. The table therefore describes the long-term age structure objective that successive treatments will work towards.
- As an example, after three 40-year cutting cycles, a group selection cutblock managed for a "low" stand structure habitat class would be made up of one-third each of patches 0–40, 41–80, and 81–120 years of age. For a cutblock with a "high" stand structure habitat class objective, the long-term age structure objective would not be met until after the fifth harvesting pass.
- This objective means that group selection harvesting should not take place in a cutblock that has a greater percentage in the 0–40 year age class than is shown in the table above. For example, a cutblock with a "low" stand structure habitat class objective that has more than 33% of its area currently less than 40 years should not be harvested.

Strategies for meeting age structure objectives:

- The first step in designing a prescription to meet this age structure objective for a specific cutblock is to determine the stand structure habitat class objective from the long-term habitat objectives map for the appropriate winter range. Maps for each winter range can be found at the following link: <http://wlapwww.gov.bc.ca/car/env_stewardship/wildlife/ecosystems/mdwr_strat/mgmtplan.html>*
- Age structure objectives are designed to be met by implementing a group selection silviculture system, in each cutblock, using the harvest proportion and cutting cycle constraints set out in Table 2. The recommended cutting cycle for all three habitat class objectives is 40 years, while the area harvested per pass varies from 20% for high habitat class to 33% for low habitat class. If a different cutting cycle is chosen, the area proportions will have to be modified in order to meet the age structure objectives in Table 1. Differences between the three stand structure habitat classes after a full rotation are pictured in Figure 5.
- Do not implement group selection cutblocks in immature stands or in stands with a high level of cumulative disturbance. Before implementing a group selection harvest, ensure that the

* This URL address is current as of January 2006, after this time frame, it is our understanding a consistent pointer will direct you to the new URL address.

TABLE 2 *Cutting cycle and percentage of harvest for group selection systems in three stand structure habitat class objectives. Note that the area of current skid trails is included as part of the area harvested.*

Stand structure habitat class objective	Area harvested per pass (%)	Cutting cycle (years)	Effective rotation (years)	Number of different aged patches in the stand mosaic after a full rotation
Low	33	40	120	3
Moderate	25	40	160	4
High	20	40	200	5

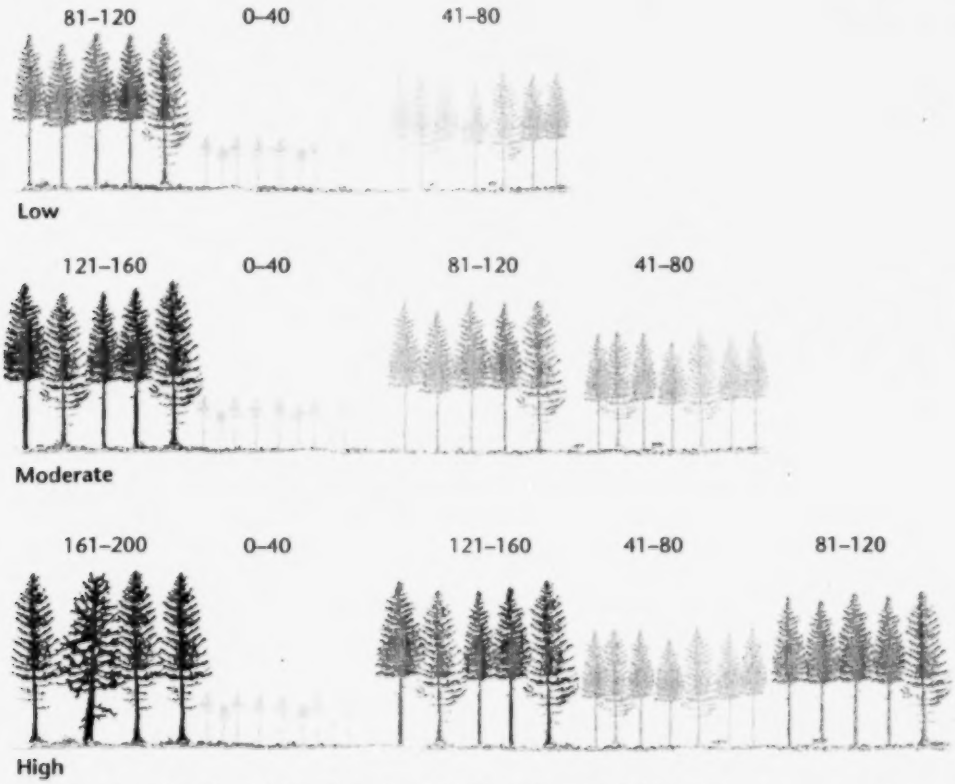


FIGURE 5 *Age cohorts for "low," "moderate," and "high" stand structure habitat classes.*

cutblock has an average merchantable basal area of 40 m^2/ha or more in the Sub-Boreal Spruce (SBS) biogeoclimatic zone or greater than 45 m^2/ha in all other subzones.

- When planning a group selection cut, include existing openings greater than 0.1 ha that are dominated by young trees (main canopy of trees < 15 m in height) as part of the current pass. For example, if the prescription was to create openings in 25% of a cutblock that already had 10% of the area in openings > 0.1 ha predominantly forested with trees < 15 m, then the harvest should only amount to an additional 15% of the area.

2.3.2 Objective 2: Species composition

On sites capable of growing Douglas-fir, achieve the following Douglas-fir composition in as short a time period as ecologically feasible:

- At least 60% Douglas-fir* for winter ranges in the following biogeoclimatic units: Interior Cedar-Hemlock (ICH), wet cool subzone of Sub-Boreal Spruce (SBSwk), moist cold subzone of Sub-Boreal Spruce (SBSmc),or moist warm subzone of Sub-Boreal Spruce (SBSmw).
- At least 80% for winter ranges in all other subzones.

* The Douglas-fir composition is calculated as the proportion of basal area of trees >12.5 cm dbh.

Comments and qualifications:

- Depending on initial stand conditions, achieving the desired species composition may require a series of management actions over an extended period of time and over several cutting cycles. On sites capable of growing Douglas-fir, the area harvested in each cutting cycle should be managed to ensure that Douglas-fir is the dominant regeneration.
- Winter ranges are dominated by sites that are capable of growing Douglas-fir. However, some areas, such as subhygric sites, may not be ecologically suitable for Douglas-fir regeneration.
- Western redcedar is present in some deep snowpack winter ranges. While mature western redcedar does not provide the good snow interception that is critical on these winter ranges, western redcedar regeneration and saplings are a valuable source of mule deer winter forage. Therefore, some western redcedar should be maintained on these winter ranges as a minor component of a predominantly Douglas-fir stand or if located adjacent to a Douglas-fir stand.

Strategies for meeting species-composition objectives:

- Create harvest openings that do not cause a high windthrow risk for residual Douglas-fir trees. Consider the size, shape, and orientation of harvest openings.
- In mixed-species stands, initial harvest entries should concentrate harvest openings in areas predominated by non–Douglas-fir species.
- Create harvest openings that minimize frost problems for Douglas-fir regeneration. Larger openings, especially in the transition snowpack zone, can result in frost problems. Openings on flat and gently sloping, toe slope, and depression topographic positions are especially prone to cold air accumulations and require special attention. Where a medium, high, or very high risk of growing-season frost (Steen et al. 1990) is expected, create smaller harvest openings and consider maintaining shelterwood cover until regeneration is above 1 m in height. Forest planners can also consider a regeneration strategy that uses a nurse crop of a frost-tolerant species. Figure 6 shows an example of using shelterwood within a group selection opening to reduce frost damage.
- Regenerate to Douglas-fir wherever ecologically possible.
  - If planting, use Douglas-fir on all sites where it will grow.
  - Protect and promote established Douglas-fir regeneration during the harvesting phase.
  - Maintain Douglas-fir in any spacing treatments. On some sites, the density of other conifers may need to be lowered by spacing treatments.
- Work to maintain or increase Douglas-fir composition in each treatment entry. In some stands, the Douglas-fir composition objective may not be able to be met in the first cutting cycle, but may take continuing efforts over several cutting cycles. In group selection harvesting, concentrate on reforesting the newly created openings to Douglas-fir.
- Locate landings in non–Douglas-fir areas where possible, especially in areas that are not ecologically capable of regenerating Douglas-fir.

- Shelterwood silviculture systems may be a useful option for stands with a very high proportion of non–Douglas-fir trees (see Appendix 6, "Shelterwood silviculture system" and Figure 7). In order to move these stands to Douglas-fir as quickly as possible, it is sometimes not an option to simply harvest the non–Douglas-fir and plant Douglas-fir because of possible growing-season frost. The planted Douglas-fir must be sheltered from frost until it reaches 1 m in height. This can be accomplished by leaving the mature Douglas-fir and some of the mature non–Douglas-fir in a shelterwood cut.

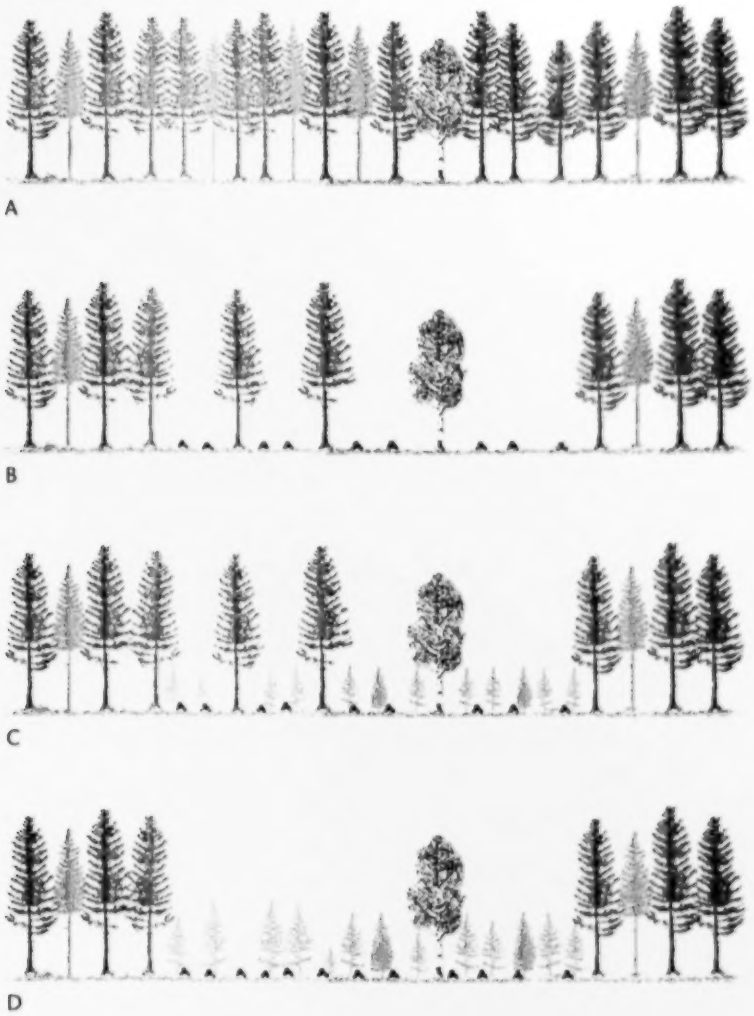


FIGURE 6 *Example use of shelterwood within a group selection system for frost-prone micro-sites. This may be used in Harvest Type D (see section 2.3.5) to meet the species-composition objective on a frost-prone site. A) The concern about frost is identified before harvesting begins. B) Some residual tree cover is left while harvesting the group selection openings. C) The openings are regenerated with Douglas-fir. D) Once the Douglas-fir regeneration is above 1 m and no longer at risk for frost, the residual conifers can be carefully removed.*

- Stands that currently have a very high proportion of lodgepole pine on sites that would support Douglas-fir will require special treatments to move towards a greater percentage of Douglas-fir over time. This could include Douglas-fir planting and pre-commercial spacing of non–Douglas-fir stems.

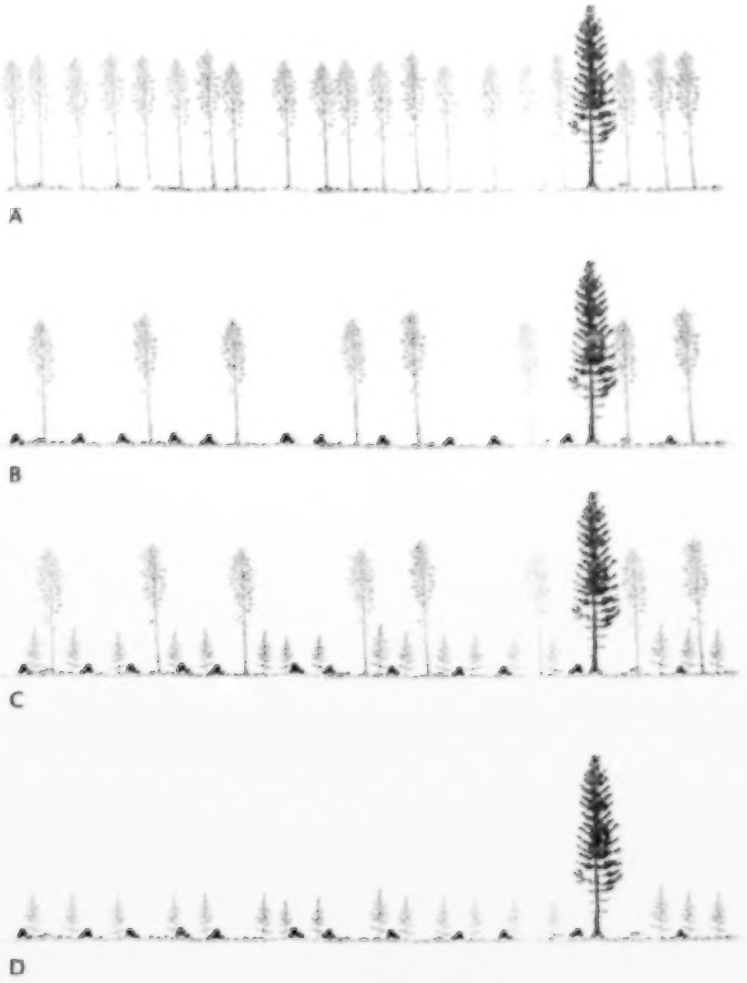


FIGURE 7 *Example of a stand with > 40% lodgepole pine (Harvest Type B, see section 2.3.5) on a frost-prone site. A) Planning for the regeneration of Douglas-fir is done prior to harvesting. B) Some residual tree cover is left, including all of the Douglas-fir, while harvesting most of the pine. C) The cutblock is regenerated with Douglas-fir. D) Once the Douglas-fir regeneration is above 1 m and no longer at risk of frost, the residual pine can be carefully removed.*

2.3.3 Objective 3: Opening size

Limit group selection opening sizes to the range shown in Table 3. Design the whole set of openings in any one pass to meet the recommended average group size.

The size ranges vary depending on three factors:

1. snowpack zone
2. slope and aspect
3. risk of growing-season frost

Opening size includes the total contiguous opening area, which could be made up of any combination of: (1) currently harvested openings, (2) natural openings, and (3) openings from any previous harvest within the past 40 years.

TABLE 3 *Objectives for group selection opening size in the transition and deep snowpack zones. The bracketed numbers refer to the recommended average opening size.*

	Opening size (ha)*		
Snowpack zone	Warm aspect sites**	Other aspects	Frost-prone sites***
Transition	0.1–0.4 (0.3)	0.1–0.7 (0.4)	0.1–0.3 (0.2)
Deep	0.1–0.4 (0.3)	0.1–1.0 (0.6)	0.1–0.4 (0.3)

* Opening sizes are measured from tree stems on the outside of the opening.

** Warm aspect sites are defined as those with slopes >10% and aspect 135–270°.

*** Sites with a summer frost hazard class of medium, high, or very high (Steen et al. 1990) should be considered frost prone.

Comments:

- Frost-prone sites may vary in size. In some situations, the entire cutblock may be in frost-prone condition, while in other situations, just a small portion of the cutblock, such as a single group selection opening in a small depression, may have serious frost hazard. *Identification of Summer Frost-prone Sites in the Cariboo Forest Region* (Steen et al. 1990) provides excellent guidance on identifying growing-season frost hazard.

Strategies for meeting opening-size objectives:

To meet opening-size objectives, forest planners can:

- plan opening sizes to meet the objectives for the appropriate snowpack zone, slope class, and potential frost condition;
- carefully lay out the skid trails and harvest openings before harvest;
- plan both current and future openings at the time of the first harvest pass; and
- consider the use of smaller opening sizes on sites with a significant windthrow risk.

2.3.4 Objective 4: Location of openings, leave areas, and access

Design the skid trail network and the location, orientation, and shape of group selection openings to ensure the following:

- Road and landing areas are minimized for current and future passes.
- Skid trail area for the block is minimized and does not exceed 10% of the block area.
- Skid trails are located at least 30 m away from ridges or topographic breaks except for trails perpendicular to the feature that are required to access timber (Figure 8).
- The amount and continuity of mature forest within 30 m either side of a ridge or topographic break is maximized.
- Disturbance of regeneration in harvest openings by later harvest passes is minimized.
- Windfirmness of the residual stand is maximized.
- Openings are distributed relatively uniformly throughout the block in each pass.
- Wildlife tree patches are maintained.

Comments:

- The direction related to topographic features applies to both major and minor ridges and topographic breaks. Buffers for major topographic features are drawn on long-term objectives maps while minor topographic features must be defined on the ground by those implementing forestry treatments or road building.
- Topographic breaks and ridges are defined as features where the slope is greater than 15% when measured from the apex of the feature to a point 15 m perpendicular to the feature or to the nearest gully bottom if this is less than 15 m away. Ridges have a slope > 15% on both sides while topographic breaks have a slope of > 15% on only one side.

Strategies for meeting objectives for locating openings, leave areas, and harvest access:

Develop a "total chance" plan for each cutblock to be harvested. This is the best way to ensure that these objectives are met.

- Total chance planning for a group selection cutblock means that the location of the skid trails and harvest patches for all passes are planned at the time of the first entry. The location of subsequent harvest patches do not have to be laid out in the field at the time of the first entry, but should be planned on paper.

Minimize skid trail area for current and future passes.

- Plan for an efficient network of permanent main skid trails that will be used for the current and subsequent harvest entries.
- Carefully flag the skid trail locations prior to harvest.
- Use the minimum skid trail widths required to remove the timber.

Minimize logging disturbance of regeneration by later harvest passes.

- Design openings and skid trails so that skid trails for later harvest passes do not need to cross regenerated openings.

- First pass openings near the cutblock boundary should be extended to the boundary wherever possible to avoid having to skid across a regenerated block in subsequent passes.

Consider windfirmness of residual stand.

- In areas where windthrow risk is moderate or high, identify the direction of expected damaging winds as part of the total chance planning process and design cutblocks taking this into account.
- Where possible, harvest microsites with a higher windthrow risk in the first pass.
- On second and subsequent passes, try not to merge new openings with previous openings containing stands less than 60 years old. If you need to merge a new opening with an existing opening or immature forest patch, locate the new opening on the upwind side facing the dominant damaging winds so that you are not opening up a new face for wind damage.
- Smaller opening sizes should be used in situations where there is a higher windthrow risk.

Reserve ridges and topographic breaks from harvest wherever possible (Figure 8).

- Locate wildlife tree patches on ridges and topographic breaks where possible.
- Minimize the contiguous length of young forests (less than 80 years old) along these topographic features.

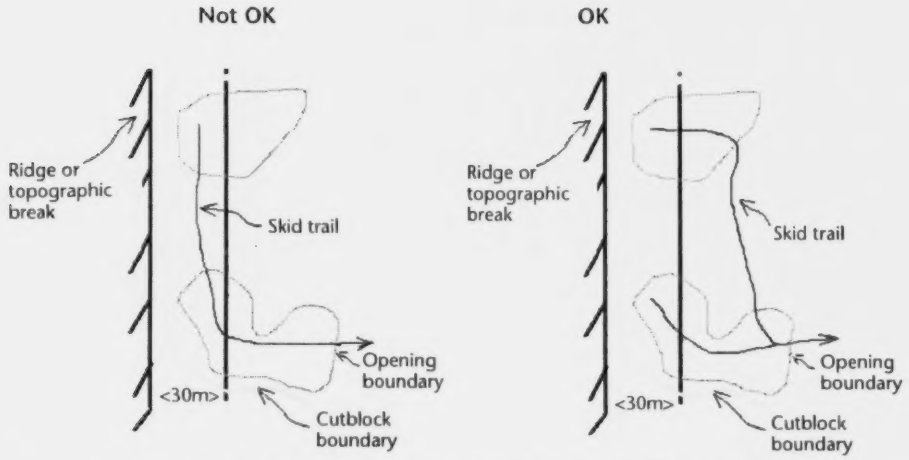


FIGURE 8 *Location of skid trails in relation to ridge or topographic break. It is acceptable to locate skid trails perpendicular to a ridge or topographic break feature to access timber, but they should not be located parallel to the feature within 30 m of the ridge or break.*

2.3.5 Objectives for individual harvest entries

The long-term objective is to bring all winter range stands in the transition and deep snowpack zones (with the exception of those on subhygric or wetter sites) into a group selection management regime (called Harvest Type D below). Based on specific stand structure, composition, or bark beetle attack situations, some stands may need other management treatments before moving into the group selection regime. This is the case for stands requiring Harvest Types A and B. Thinning (Harvest Type C) may be a useful initial treatment on some very dense stands. Harvest Type E is for wetter sites that do not require harvest treatments designed for mule deer habitat management. The box below gives a general description of each harvest type and Table 4 provides objectives and strategies for each. Table 5 shows the sequence of management steps required to deal with various stand conditions.

Harvest Opportunity Types

- **Harvest Type A—Douglas-fir bark beetle sanitation** involves the removal of individual trees currently infested by Douglas-fir bark beetles. The objective is to minimize the spread of bark beetles with minimal harvesting of, or damage to, the stand, including non-infested wildlife trees. Skid trails should be narrow and located to minimize harvest or damage of Douglas-fir trees > 22.5 cm diameter at breast height (dbh).

- **Harvest Type B—Lodgepole pine selective harvest** involves the harvest of mature lodgepole pine in stands with > 40% lodgepole pine in the merchantable stand. The objective is to harvest most of the pine stems with minimal damage to existing Douglas-fir and to encourage Douglas-fir regeneration on ecologically suitable sites.

- **Harvest Type C—Thinning-from-below** involves harvest of stems between 12.5 and 37.5 cm dbh in stands with a dense pole layer. The objective is to thin the stand by removing non–Douglas-fir stems and some small, lower-vigour Douglas-fir to increase the vigour and growing space for residual Douglas-fir stems. It is very important to minimize the harvest and damage of non-target stems.

- **Harvest Type D—Small group selection system** involves selection harvest of small groups amounting to 20, 25, or 33% of the area per pass (depending on the stand structure objective) on a 40-year cutting cycle. The size of harvest groups ranges from 0.1 ha to 1.0 ha, depending on the snowpack zone and site conditions. This silviculture system will produce a multi-aged forest stand made up of small even-aged patches. Compared to larger openings, the small harvest openings will produce shrub forage within a matrix of forested habitat, making it more accessible in deeper snow conditions. The openings should be large enough to allow Douglas-fir regeneration and small enough to minimize frost problems. **As indicated in Table 5, the long-term objective is to manage all transition and deep snowpack zone stands using this silviculture system, except those on subhygric sites with < 40% Douglas-fir.**

- **Harvest Type E—Harvest without mule deer winter range constraints** in stands that are subhygric or wetter and have < 40% Douglas-fir.

TABLE 4 *Harvest Opportunity Types for mule deer winter ranges in the transition and deep snowpack zones within the Cariboo-Chilcotin. The term "logging damage" in this table refers to crown or bark damage. Damage is defined as: (1) loss of one-quarter or more of the crown or (2) loss of either 1000 cm² of bark or loss of bark from one-third of the circumference of the tree.*

Harvest opportunity type	Objectives	Strategies and comments
A. Douglas-fir bark beetle sanitation	• **Remove currently infested stems with minimal damage to, or harvest of, green stems.** • **The volume of non-target stems removed must be less than 10% of the volume of infested stems removed.** • **Maintain some large (40 cm dbh) grey attack or non-infested red attack trees well distributed throughout the treated block.** • **Within Old Growth Management Areas (OGMAs), do not salvage any dead trees, and carry out sanitation harvest only in accordance with Cariboo-Chilcotin Land Use Plan (CCLUP) Biodiversity Update #7.**	Minimize harvest of non-infested stems and maintain grey attack as follows: • Design minimum skid trail network to access only currently infested stems. Cut no green Douglas-fir > 37.5 cm to access currently infested trees. • Retain all grey attack and non-infested red attack trees that would require additional skid trail to access. • If wildlife tree patches (WTP) have not been designated, retain all safe, grey attack or non-infested red attack trees accessed by skid trails that have been built to harvest currently infested stems. No dead trees should be removed from WTP. • Carefully map and reconnoiter beetle attack, and promptly remove infested stems to minimize beetle damage. Careful use of trap trees may also be considered.
B. Pine selective harvest in stands with greater than 40% lodgepole pine where greater than 50% of the pine component is dead or at high risk of mountain pine beetle (MPB) mortality.	• **Apply this treatment only in stands with greater than 40% lodgepole pine where greater than 50% of the pine component is dead or at high risk for MPB mortality.** • **Remove lodgepole pine with minimal damage to Douglas-fir stems.** • **Harvest or damage to Douglas-fir must not exceed 15% for stems 22.5–37.5 cm dbh and 5% for stems > 37.5 cm dbh (including skid trail development) of the pre-harvest basal area of Douglas-fir stems in each of these two diameter class groupings.** • **Lodgepole pine located in patches less than 0.1 ha in area is a low priority for salvage harvest and Douglas-fir stems > 22.5 cm dbh should not be cut to access these small pine patches.** • **Regenerate to Douglas-fir wherever ecologically possible.** • **Minimize skid trail area.**	• Locate landings in non–Douglas-fir areas whenever possible. • To achieve non-target harvest and damage objectives will require careful pre-harvest planning and layout of skid trails and may require leaving some scattered lodgepole pine. • The level and distribution of harvest should be carefully designed to leave a windfirm residual stand and to not create frost problems for regenerating Douglas-fir. • Protect and promote established Douglas-fir regeneration. • Consider leaving lodgepole pine located singly or in small patches if harvesting would require cutting Douglas-fir for access to the pine. • Do not plant non–Douglas-fir species unless Douglas-fir is not ecologically viable on the site.

TABLE 4 *Continued*

Harvest opportunity type	Objectives	Strategies and comments
B. *(continued)*		• Great care must be taken to maintain existing snags and manage for snag recruitment. Use of wildlife tree patches (WTP) is the most effective way of managing for snags and is valuable for managing other values, including coarse woody debris (CWD) and undisturbed forest floor. • This harvest type may be applicable to stands with > 50% spruce where more than half of the spruce has been killed or infested with spruce bark beetle.
C. Thinning-from-below in stands with a dense pole layer	• Thin-from-below in stems 12.5–37.5 cm diameter at breast height (dbh). Thinning-from-below means that the less vigorous trees in the intermediate and suppressed canopy layers are the first priority for removal. • Do not target any Douglas-fir stems > 37.5 cm dbh for harvest. Minimize unavoidable harvest or damage of these stems. In no case should the harvest or damage of these trees exceed 10% of the pre-harvest basal area of the trees > 37.5 cm dbh. • Retain a minimum of 75% of the pre-harvest conifer basal area (stems > 12.5 cm dbh). Note that the residual basal area is the average for the net harvested area (excluding roads, landings, and wildlife tree patches [WTP]). • Minimize area covered by skid trails. Area covered by skid trails must not exceed 10% of the net harvested area (excluding roads, landings, and WTP). • In mixed-species stands, target species other than Douglas-fir for removal first.	• Minimize unavoidable harvest or damage of Douglas-fir stems > 37.5 cm dbh by ensuring that skid trails avoid areas containing these larger trees. • Locate landings in non–Douglas-fir areas and in areas with little or no Douglas-fir > 37.5 cm dbh whenever possible. • Great care must be taken to maintain existing snags and manage for snag recruitment. Use of WTP is the most effective way of managing for snags and is valuable for managing other values, including coarse woody debris (CWD) and undisturbed forest floor.

TABLE 4 *Continued*

Harvest opportunity type	Objectives	Strategies and comments

D. Small group selection designed for mule deer winter range management	• Manage stand with small group selection to maintain or enhance mule deer winter habitat. Apply harvest proportions and cutting cycles appropriate to the long-term stand structure habitat class as shown in Table 2.
	• Do not implement the first pass of a group selection harvest treatment on stands with a basal area less than 45 m^2 in ICH, or less than 40 m^2 in other zones.
	• Use appropriate range of opening sizes as specified in Table 3.
	• Minimize area covered by skid trails. Area covered by skid trails must not exceed 10% of the net harvested area (excluding roads, landings, and wildlife tree patches [WTP]).
	• Design harvest pattern to minimize the risk of frost and wind damage.
	• Regenerate openings to predominantly Douglas-fir.
		• Site plan for each harvest entry should specify:
		  • mean and maximum harvest opening size;
		  • how residual stems and snags will be protected; and
		  • cutting cycle and harvest proportion.
		• Locate landings in non-Douglas-fir areas wherever possible.
		• Always plant Douglas-fir if it is ecologically viable for the site.
		• Because of the short cutting cycle (40 years), great care must be taken to maintain existing snags and manage for snag recruitment. Use of WTP is the most effective way of managing for snags and is useful for managing other values, including coarse woody debris and undisturbed forest floor, and for maintaining forest cover on critical topographic features.
		• Protect existing Douglas-fir regeneration where possible.
		• Maintain Douglas-fir in juvenile spacing treatments.
		• In most stands, at least 20 years should be allowed between thinning treatments and subsequent group selection harvests to allow for recovery of snow interception capability.
		• On cool aspect stands (slope > 10% aspect 271–360° and 0–134°), thinning of a narrow strip (one tree length) on the south and west sides (135–270°) of the group selection opening could be considered to provide greater light for Douglas-fir regeneration.

2.3.6 Timing and sequence of management actions
This table shows the sequence of management steps that is required to deal with various stand conditions and to move various stand structures towards the desired long-term condition while maintaining adequate habitat quality. The four harvest types are fully described in Section 2.3.5.

TABLE 5 *Timing and sequence of management actions for various stand types and conditions*

Applicable stand type or situation	Progression towards long-term stand structure objectives		
	1st pass	2nd pass	3rd and subsequent passes
Stands with significant current Douglas-fir beetle	Apply Douglas-fir beetle sanitation (**Harvest Type A**). Then apply harvest treatments appropriate to the stand type in column 1 of this table.		
Stands with greater than 40% lodgepole pine where greater than 50% of the pine component is dead or at high risk of mountain pine beetle (MPB) mortality	Harvest of MPB-infested stems with minimal damage to Douglas-fir (**Harvest Type B**)	Apply first pass of group selection when stand basal area ≥ 45 m^2 in ICH or ≥ 40 m^2 in other zones (**Harvest Type D**)	At 40-year intervals apply subsequent group selection passes (**Harvest Type D**)
Stands with 40% or less lodgepole pine and all other mixed stands that are mesic and drier or that have 40% or greater Douglas-fir	Apply "thinning from below" (**Harvest Type C**) or Apply first pass of group selection when stand basal area ≥ 45 m^2 in ICH or ≥ 40 m^2 in other zones (**Harvest Type D**)	After 40 years apply 2nd pass of group selection (**Harvest Type D**)	
Subhygric or wetter sites with < 40% Douglas-fir	Do not need to manage for mule deer winter range stand structure values (**Harvest Type E**)		
Old Growth Management Areas	No harvest except very limited bark beetle sanitation in situations where the criteria in Biodiversity Updates #6 (CCLUP 2004), #7 (CCLUP 2005a) and #13 (CCLUP 2005b) are met for mountain pine beetle and Douglas-fir beetle.		

3 PLANNING FOREST HARVESTS TO MEET WINTER RANGE OBJECTIVES

This section contains two items to help those who are planning forest harvest operations on mule deer winter ranges in the Cariboo-Chilcotin transition and deep snowpack zones. These may also be useful for those responsible for monitoring and approving these operations.

3.1 Basic Steps for Planning a Cutblock on Winter Range

1. Obtain a copy of the applicable long-term objectives map and note the following information from it for the cutblock area that you are planning to harvest:
   a. the long-term stand structure habitat class
   b. the location of any topographic buffers in or near the cutblock
   c. the biogeoclimatic unit and snowpack zone (also see Appendix 1)
2. Determine the current stand structure and composition of the cutblock area you are planning for management. Stratify the cutblock as required to provide relatively uniform treatment units.
3. Determine the appropriate Harvest Opportunity Type for each treatment unit.
4. Develop a site plan to meet the access objectives, overall stand objectives, and objectives for the appropriate Harvest Opportunity Type. If planning a group selection harvest, develop a total chance cutblock plan.

3.2 Checklist for Forest Harvest Planning

Forest Stewardship Plan (FSP) requirements

- ☐ Have the access and stand-level objectives for management of mule deer winter range been clearly documented in the FSP?

Has the following information been identified for each proposed cutblock in the plan?

- ☐ Winter range name
- ☐ Habitat management zone
- ☐ Long-term stand structure habitat class objective
- ☐ Proposed Harvest Opportunity Type

Overall stand-level requirements

Are plans in place to ensure that each Harvest Treatment is implemented in the field to meet the following objectives?

- ☐ Species composition is at least 80% Douglas-fir over time (60% in the ICH, SBSwk, SBSmc, or SBSmw biogeoclimatic units).
- ☐ Openings are located and oriented to reduce windthrow risk for residual stands.
- ☐ No roads or landings are planned in topographic buffers or within 100 m of topographic breaks or ridges.
- ☐ Skid trails are located at least 30 m from topographic breaks and ridges except for trails perpendicular to the feature that are absolutely required to access adjacent timber.
- ☐ Skid trail area is minimized and does not exceed 10% of the cutblock area.
- ☐ Skid trail area is included in percent removal targets for group selection harvest.
- ☐ Wildlife tree patches are used to buffer ridges and topographic breaks wherever possible.

Specific harvest type requirements

Are plans in place to ensure that each harvest treatment is implemented in the field to meet the following objectives?

Harvest Type A: Douglas-fir beetle sanitation

- ☐ Only currently infested stems are marked for removal.
- ☐ Non-target volume is less than 10% of volume of infested stems marked for removal.
- ☐ Strategy is in place to ensure continuous recruitment of well-distributed snags.

Harvest Type B: Lodgepole pine selective harvest

- ☐ The proposed cutblock is composed of greater than 40% lodgepole pine where 50% of the pine is dead or at serious risk of mountain pine beetle mortality.
- ☐ Damage to Douglas-fir is limited to a maximum of 5% for stems > 37.5 cm dbh and 15% for stems 22.5–37.5 cm dbh.
- ☐ Lodgepole pine located in patches less than 0.1 ha in area is a low priority for salvage harvest and Douglas-fir stems > 22.5 cm dbh should not be cut to access this pine in small patches.
- ☐ Regeneration plans are in place to ensure recruitment of Douglas-fir wherever ecologically suitable.

Harvest Type C: Thinning-from-below

- ☐ No Douglas-fir > 37.5 cm dbh is targeted for harvest.
- ☐ Incidental harvest or damage to Douglas-fir > 37.5 cm dbh will not exceed 10% of the basal area of Douglas-fir stems > 37.5 cm dbh.
- ☐ A minimum of 75% of pre-harvest conifer basal area will be retained.
- ☐ Species other than Douglas-fir are the first priority for harvest.

Harvest Type D: Small group selection

- ☐ A minimum of 45 m^2 in the ICH (or 40 m^2 basal area in other subzones) exists in the stand prior to implementing Harvest Type D.
- ☐ Stand age structure is consistent with the long-term objectives map (see Table 1) for group selection blocks.
- ☐ Cutting cycles and harvest proportions consistent with Table 2 are used for the appropriate stand structure habitat class objective.
- ☐ Opening sizes for group selection blocks are consistent with Table 3.
- ☐ Regeneration plans are in place to ensure recruitment of Douglas-fir wherever ecologically possible.

APPENDIX 1 SNOWPACK ZONES IN THE CARIBOO-CHILCOTIN

A map of mule deer winter ranges and snowpack zones in the winter ranges in the Cariboo-Chilcotin can be accessed at the following internet address.

<http://wlapwww.gov.bc.ca/car/env_stewardship/wildlife/ecosystems/mdwr_strat/mgmtplan.html>*

Table A1.1 defines all snowpack zones in the Cariboo-Chilcotin based on biogeoclimatic units. Note that the SBSmh is split into two snowpack zones.

TABLE A1.1 *Definition of snowpack zones for mule deer winter range management in the Cariboo-Chilcotin*

Snowpack zone	Biogeoclimatic zones and subzones[a]	Applicable management plan
Shallow	BG-all, IDFxm, IDFxw	*Management Plan for Shallow and Moderate Snowpack Zones* (2002, revised 2006)
Moderate	IDFdk 3 & 4, SBPSxc, MSxk, SBSmh[b]	
Transition	SBSdw1& 2, SBPsmk, SBPsdc, MSxv, SBSmh[b]	*Management Plan for Transition and Deep Snowpack Zones (2005)*
Deep	IDFmw2, ICH-all, SBSwk, SBSmc, SBSmw	

a Biogeoclimatic zones: BG=Bunchgrass, IDF=Interior Douglas-fir, SBPS=Sub-Boreal Pine–Spruce, MS=Montane Spruce, SBS=Sub-Boreal Spruce, ICH=Interior Cedar-Hemlock.

b Note that the SBSmh is shown in two snowpack zones. The portion of the SBSmh south of Quesnel is in the moderate snowpack zone while the portions of the SBSmh north and east of Quesnel are in the transition snowpack zone.

APPENDIX 2 BIODIVERSITY AND SPECIAL WILDLIFE SPECIES MANAGEMENT ON WINTER RANGES

Mule deer and their winter habitat are components of ecosystems. These ecosystems support diverse biological communities, including some species that have been identified for special management under the province's *Identified Wildlife Strategy* and species that have been designated as red listed (extirpated, endangered, or threatened) or blue listed (vulnerable). These species will be collectively referred to below as "special management species." Since deer winter habitats are part of broader ecosystems and overlap habitat for these special species, management recommendations for mule deer winter range could positively or negatively affect these species, as well as other species in the wider biological community. Significant effort and Cariboo-Chilcotin Land Use Plan (CCLUP) conservation credits are being expended in planning and managing the forest habitat on mule deer winter ranges. It is important to understand the needs of these other important species and to coordinate their management as much as possible with mule deer recommendations.

This section will: (1) discuss how mule deer winter range plan direction contributes to general biodiversity management, (2) review the "special management" species that overlap with mule deer winter ranges in the transition and deep snowpack zones, (3) discuss how mule deer winter range plan direction addresses some of the known habitat requirements of these special management species, and (4) discuss potential habitat management problems that could occur without careful management.

The management direction found in mule deer winter range plans contributes to forest biodiversity management in the following ways:

- It maintains and creates structural diversity over

* This URL address is current as of January 2006, after this time frame, it is our understanding a consistent pointer will direct you to the new URL address.

the landscape by managing for three different stand structure habitat classes.
- It encourages stand-level structural diversity including:
  - stands made up of a mosaic of different aged patches;
  - stands made up of a larger proportion of large trees; and
  - careful management of wildlife trees.

The *Forest Practices Code*'s "Species and Plant Community Accounts for Identified Wildlife" (Volume 1, 1997) is a good source of information on many of the species listed here. The following special management species use habitat that overlaps transition and deep snowpack mule deer winter ranges:

- **Fisher** use areas with larger and older trees. These trees increase snow interception, allowing for easier movement and foraging in winter. Cavities in larger-diameter trees and coarse woody debris are also important for resting and as natal dens.
- Several **bat** species are present, but there is limited information on their habitat requirements. However, we do know that large trees and snags are important to some of them. These bat species include:
  - the silver-haired bat, which roosts high up in large trees; and
  - Townsend's big-eared bat (blue-listed)
- **Sandhill Crane** nest in shallow wetlands. The *Forest Practices Code*'s "identified wildlife" species entry for Sandhill Crane states that "forested buffer zones around nesting marshes are likely critical for relatively small (< 10 ha) wetlands."
- **Northern Goshawk** nest and feed in stands of large trees with dense canopies and relatively open understoreys with a supply of coarse woody debris.
- **Platform nesters** such as eagles, ospreys, and herons nest in large trees, which often have dead tops. These nests are specifically mentioned and protected under the *British Columbia Wildlife Act*.

The following direction contained in mule deer winter range plans will help to maintain the habitat for these special management species:

- Designate "topographic buffer zones" centred on major ridges and topographic breaks. These buffer zones:
  - will be managed for high or moderate habitat class, which will maintain a greater proportion of large trees; and
  - restrict roads and skid trials, resulting in reduced habitat alteration and human access.
- Maintain a significantly higher proportion of larger, older trees because of extended rotations.
- Promote careful wildlife tree management to both maintain and recruit good wildlife trees.
- Locate a larger proportion of Old Growth Management Areas (OGMAs) on mule deer winter ranges than on the surrounding landscape. This overlap should allow for a greater focus on conservative management for the benefit of identified species.

Management cautions

Mule deer management plans and prescriptions will generally help to maintain habitat attributes required for special management species and biodiversity. However, prescriptions need to be carefully designed and implemented. We offer the following cautions:

- **Reductions in wildlife trees** The mule deer winter range plan direction allows for relatively short cutting cycles (recommended minimum of 40 years). These frequent repeated entries can result in low snag survival and recruitment if they are not carefully managed and conserved at each entry. Worker safety requirements can result in many existing snags being felled at each harvest entry. Also, tree quality criteria applied in thinning treatments may remove many of the trees that would otherwise have died and recruited to become snags. Unless a prescribed density of live, "unhealthy" wildlife trees (Class 2 wildlife trees) is maintained, the recruitment of snags can be greatly diminished.
- **New knowledge** As new knowledge is gained about the wildlife species discussed here and any additional species of concern, refinements may need to be made in application of future prescriptions.
- **Salvage programs** Salvage programs, unless very carefully managed, could cause large reductions in wildlife tree retention and recruitment, resulting in seriously degraded wildlife habitat. Also, care will be required to ensure that salvage harvesters do not locate skid trails parallel to ridges and topographic breaks.

Late 1970s	Ministry of Environment biologists realize that mule deer winter range (MDWR) values are being lost through timber harvesting that does not consider mule deer requirements.
1980	Research conducted by the B.C. Forest Service starts within the region to address what mule deer need in the winter and how forest management can meet those needs.
1983	Pilot block of experimental logging using low-volume selection system on MDWR is conducted on the Knife Creek winter range in the Williams Lake District.
1984	First replicated experimental low-volume selection system on MDWR is conducted on the Knife Creek winter range.
1985	Replicated research on low-volume selection system is conducted on the Big Lake South MDWR in the 100 Mile Forest District.
1986	Land Management Handbook 13, the Mule Deer Handbook, is released.
1986	Juvenile spacing trials are initiated on MDWR in the 100 Mile Forest District.
1987	Mule Deer pamphlet, *A Guide for Loggers*, is released
1987	University of British Columbia/Alex Fraser Research Forest is created, including two winter ranges. Ongoing operational testing of mule deer habitat management is initiated.
Late 1980s and early 1990s	MDWR boundaries are revised by the Ministry of Environment, substantially reducing the area (reduced by ~ 42 000 ha) in managed winter range (13 MDWRS are completely removed).
Late 1980s	Revised MDWR boundaries are used for Timber Supply Review (TSR 1).
1988–1998	Numerous articles are published in journals, government publications, and conference proceedings to document research results on MDWR.
1990	"Clumpy spacing" is developed and a trial established on the Knife Creek MDWR.
1994–1995	Cariboo Chilcotin Land-Use Plan (CCLUP) and supporting documents are released identifying MDWR as an important management objective and specifying the MDWRS to be managed.
1996	MDWR Strategy as mandated by the CCLUP is released by MDWR Committee, documenting status of the approximate 100 MDWRS in the region.
1998	CCLUP Integration Report is released, providing short- and long-term direction on mule deer management.

1998 Stand structure mapping of MDWRs begins.

1999 First MDWR management plan is released as a draft template.

2000 "Grassland Benchmark" from the *Grassland Strategy* is incorporated into spatial long-term objectives for MDWR.

2000 Extensive review of draft MDWR plan template by Cariboo Lumber Manufacturers' Association is completed.

2000 Revisions are made to MDWR plan template, including but not limited to:
- non-productive land mapped and out of long-term objectives; and
- OGMAs to overlap "high" habitat and "topographic buffers" as much as possible.

2000 Extension Note #25A, *Structural Definitions of MDWR Habitat in the IDF Zone*, is released.

2000 Interim guidelines are provided for MDWRs prior to plan completion, including specific direction by snowpack zones:
1) shallow and moderate snowpack zones
2) transition snowpack zone
3) deep and very deep snowpack zones

2001 The Cariboo Mid Coast Inter-Agency Management Committee (IAMC) endorses the Williams Lake–Chimney Mule Deer Winter Range Management Plan as the template for completion of the remaining winter range plans.

2001 Web site is created to easily access status of MDWR planning.

2001 Greatly simplified planning approach is developed and presented to IAMC and Cariboo Lumber Manufacturers' Association (CLMA), including four components:
1) *Management Plan for Shallow and Moderate Snowpack Zones*
2) *Management Plan for Transition and Deep Snowpack Zones*
3) *Long-term Objectives Map for Individual Winter Ranges*
4) *Transition-Period Harvest Opportunity Plans for Individual Winter Ranges.*

2001–2004 Boundary adjustments are completed for MDWR in the 100 Mile, Williams Lake, and Quesnel Timber Supply Areas (TSAs). This substantially reduced the area to be managed as MDWR, including:
- four MDWRs removed completely;
- 80 144 ha net reduction in area of MDWR; and
- 8918 ha net reduction in Douglas-fir area of MDWR.

2002 *Management Plan for Mule Deer Winter Ranges in the Shallow and Moderate Snowpack Zones* is completed, incorporating the following changes, including:
- increasing maximum area in skid trails to 10%;
- increasing non-target harvest of Douglas-fir to 15% and 5% for small and large trees, respectively; and
- increasing the availability of harvest opportunities.

2002 Stand structure mapping is completed for 34 winter ranges.

2004 Boundaries for mule deer ungulate winter range are legalized under *Government Action Regulation* for purposes of planning using the *Forest and Range Practices Act*.

2005 *Management Plan for Mule Deer Winter Ranges in the Transition and Deep Snowpack Zones* is completed.

2005 Long-term objectives maps are completed and posted on the web site for Quesnel, Williams Lake and 100 Mile, and Chilcotin forest districts.

2005 All MDWR planning work is completed for the approximate 100 MDWRS in the Cariboo-Chilcotin. This is one year before the CCLUP deadline of 2006.

APPENDIX 4 USE OF GROUP SELECTION ON MODERATE SNOWPACK WINTER RANGES

The north-facing slopes (aspect 315–60° with slope greater than 20%) in the moderate snowpack portions of the following winter ranges are to be managed using the stand-level guidance for the transition snowpack zone. Therefore, instead of applying single-tree selection to these sites, they should be harvested using the stand-level guidance for the transition snowpack zone from Section 2.3 of this plan. This will mean that they will usually be managed using a group selection silviculture system.

These cool aspect stands in the moderate snowpack zone are suited to the same management guidance as for transition snowpack winter ranges. This is because their proximity to the transition snowpack zone boundary and their cool aspect result in ecological similarities to transition snowpack zone stands.

Williams Lake Timber Supply Area
McLeese Lake
Hawks Creek
Borland Valley
Jones Creek
Knife Creek
Enterprise

100 Mile Timber Supply Area
111 Mile
Lac la Hache – North
Lac la Hache – South
Buffalo Creek
Horse Lake
Fawn Lake
Watch Lake

Quesnel Timber Supply Area
Alix-Honeyburn
Australian-Alix
Narcosli

Cutblock An area that is planned as a unit for harvesting and long-term forest management. In the context of group selection management, the cutblock is the area encompassed by the full set of harvest passes to be completed over a rotation.

Cutting cycle The time interval between harvest entries into a forest stand.

Habitat management zones Zones designated on **long-term spatial objectives maps** for each winter range. These zones are used in the Mule Deer Winter Range Strategy to define the location of harvest opportunities during the transition period (until 2026) and occasionally to define areas that have special management requirements or opportunities.

Group selection opening One of many small openings in the forest canopy created by a group selection harvest pass. In time, each opening will be reforested and its trees will grow up as a small even-aged patch in the multi-aged block that results from periodic harvest entries.

Group selection silviculture system A selection silviculture system in which small groups of trees (up to 1 ha in area, but smaller in recommended mule deer habitat prescriptions) are periodically harvested, resulting in an uneven-aged forest stand made up of a mosaic of small even-aged patches. Stand structure is regulated in group selection harvesting by cutting a specified proportion of the total area of the cutblock at each harvest entry and by specifying the group size and cutting cycle.

Habitat Risk Class A classification applied to each winter range resulting from a broad-level habitat risk assessment comparing current winter range conditions to desired conditions.

Harvest Opportunity Types A description of harvesting opportunities available on mule deer winter ranges from now until the end of the transition period in 2026. These harvest types are designed to meet the integrated timber and mule deer habitat direction given in the *Cariboo-Chilcotin Land Use Plan Integration Report*.

Logging damage For the purposes of this mule deer strategy, logging damage is defined as follows:

- Crown damage – Loss of one-quarter or more of the crown.
- Bark damage – Loss of either 1000 cm^2 of bark or loss of bark from one-third of the circumference of the tree.

Ridges and topographic breaks For the purposes of this plan, topographic breaks and ridges are defined as features where the slope is greater than 15% when measured from the apex of the feature to a point 15 m perpendicular to the feature or to the nearest gully bottom if this is less than 15 m away. Ridges have a slope > 15% on both sides while topographic breaks have a slope of > 15% on only one side. These areas are important bedding and travel areas for mule deer.

Shelterwood silviculture system A silvicultural system in which mature trees are removed in a series of cuts to achieve a new even-aged stand under the shelter of remaining trees.

Single-tree selection silviculture system A selection silviculture system in which single trees or clumps of two to six trees are periodically harvested, resulting in an multi-storied uneven-aged forest stand with trees in all diameter classes. In the mule deer habitat prescriptions, single-tree selection will usually include an element of thinning-from-below. Stand structure is regulated in single-tree selection harvesting by retaining a specified basal area in each diameter class.

Skid trail For the purpose of the skid-trail objectives in this plan, skid trails refer to main trails where typically full drags are taken. For example, if a line skidder backs off the main trail to pull in single trees, these tracks off the main trail are not included in the 10% limit. Similarly, if a feller-buncher carries trees to a main trail, then the area travelled off the main trail (while carrying cut trees) is not included in the 10% maximum.

Stand An area of forest with relatively homogeneous forest structure and composition, such as a forest cover polygon.

Stand structure habitat class A stand-level classification used to define three different stand structure management objectives for mule deer habitat. For transition and deep snowpack zones, differences between the classes are based on differences in the proportion of various age classes within managed cutblocks. All habitat classes have common objectives to maintain or create multi-storied, uneven-aged stands dominated by Douglas-fir. The long-term objectives map for each winter range shows the distribution of the three habitat classes on the winter range.

Thinning-from-below A form of stand thinning that concentrates harvest on suppressed and intermediate canopy layers. This type of thinning is designed to reduce self-thinning mortality and to concentrate future growth on the larger and more vigorous stems.

Topographic buffer A buffer area surrounding a major ridge or topographic break. These areas are important travel and bedding areas for mule deer and are identified on long-term objective maps for individual winter ranges.

APPENDIX 6 APPLICABLE SILVICULTURAL SYSTEMS AND TREATMENTS

This appendix will provide background information on the silviculture treatments recommended in this plan. Sections on group selection, shelterwood, and "thinning-from-below" will define and discuss the general concept of each and discuss applying them on mule deer winter range in the Cariboo-Chilcotin.

Ecological differences between Douglas-fir forests require different silvicultural approaches to maintain Douglas-fir stands that meet the winter needs of deer in the various snowpack zones in the Cariboo-Chilcotin. As compared to the shallow and moderate snowpack zones, where "clumpy single-tree selection" is recommended, mature Douglas-fir forests in the transition and deep snowpack zones are made up of taller trees with significantly higher basal area per hectare. Individual trees tend to have narrower crowns, but grow at greater densities. Also, Douglas-fir trees become increasingly intolerant to shade in these wetter climates. In the transition and deep snowpack zones, Douglas-fir stands tend to grow in a more restricted set of site conditions, focused more on ridges and warm aspect slopes, and tend to have greater overstorey species diversity. Climatic differences include greater snowpack and greater risk of growing-season frost, especially in the Sub-Boreal Spruce and Sub-Boreal Pine–Spruce biogeoclimatic zones.

The Ministry of Forests and Range has produced a helpful "Introduction to Silviculture Systems" that can be found at the following Web site:

<http://www.for.gov.bc.ca/HFP/PUBS/SSIntroworkbook/index.htm>

Group Selection Silviculture System

Group selection is defined as "a silvicultural system that removes trees in defined groups to create stand openings with a width less than two times the height of adjacent mature trees, and that manages the area as an uneven-aged stand" (B.C. Ministry of Forests 1995). While we generally follow this definition, the width of harvest group openings may occasionally be greater than two tree heights. Group selection creates an uneven-aged stand composed of a mosaic of small even-aged patches of various ages. Group selection was chosen for its ability to create and maintain the type of forest mosaics required for deer winter habitat. Also, group selection is relatively easy to apply and, in these wetter ecosystems, results are more certain. The characteristics of stands managed by group selection are determined by objectives for:

- the proportion of the area to be cut in each pass;
- the frequency of harvest passes;
- the maintenance and regeneration of desired species;
- the size and distribution of harvest openings; and
- the shape and orientation of openings.

The following paragraphs will discuss how these objectives were designed to produce a group selection system to meet the habitat and silvicultural requirements for mule deer winter range in the transition and deep snowpack zones.

Age structure objectives

The cutblock age structure results from the proportion of the cutblock cut at each pass, and the frequency of harvest passes. The age of each patch within the mosaic created through group selection provides different habitat characteristics for deer, as shown in Table A6.1. For example, snow interception and litterfall production increase with age, while rooted forage is usually most abundant in young and older forest patches. The habitat characteristics of the whole cutblock are a combined effect of the ages of all the patches within it. For example, in low stand structure habitat, only one-third of the cutblock will be made up of patches 80 years or older and thus only one-third of the cutblock is ever in a condition to provide significant snow interception. In contrast, in a cutblock managed for high stand structure habitat, 60% of the area provides significant snow interception.

The spatial arrangement of these different aged patches within the cutblock is also significant. For example, it is important to plan harvesting in such a way that deer can readily find travel routes made up of relatively well-connected patches with good snow interception. This will obviously be easier to accomplish in areas managed for high stand structure habitat than in areas managed for low stand structure habitat because a larger proportion of each cutblock at any point in time will be made up of older aged patches, as shown in Figure A6.1.

TABLE A6.1 *Relative quality of habitat attributes as a function of Douglas-fir patch age in transition and deep snowpack winter range stands*

	Douglas-fir patch age (years)				
Habitat attribute	0–40	41–80	81–120	121–160	161–200
Snow interception	NA	+	+++	++++	++++
Litterfall	NA	+	++	+++	++++
Rooted forage biomass	+++++	++	++	+++	+++

Note: Increasing relative habitat quality for each attribute is indicated by increasing number of plus signs.

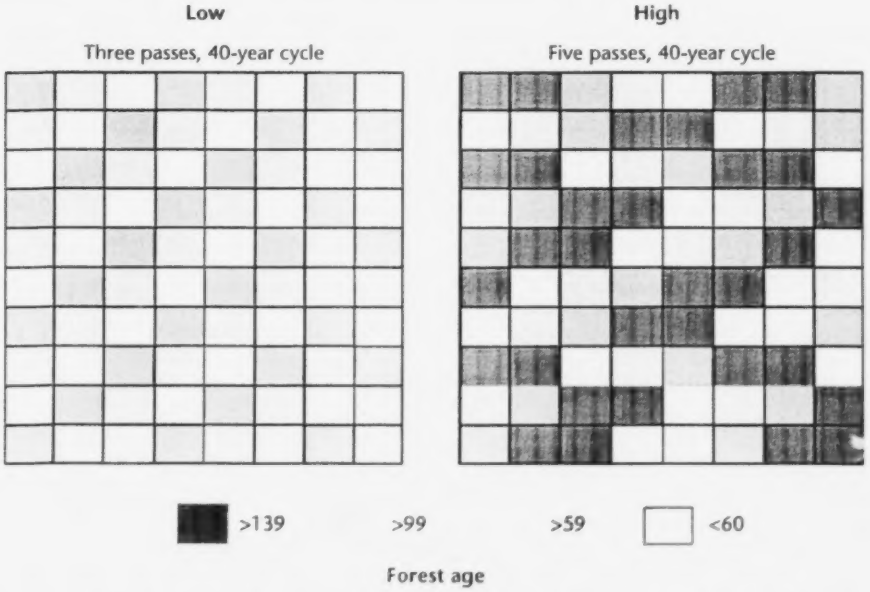


FIGURE A6.1 *Schematic representation of a stand managed with different stand structure class objectives at middle of cutting cycle.*

The group selection cutblocks on the left and the right of Figure A6.1 are managed to meet low and high stand structure habitat objectives, respectively. The colours represent age class (at the middle of the cutting cycle) for the various patches within the stand mosaic. The two shades of green represent habitat old enough to provide adequate snow interception to allow deer movement in deep snow conditions without excessive energy costs.

Species composition objective

Douglas-fir has several important characteristics that make it uniquely valuable for mule deer winter range habitat (Armleder and Dawson 1992). Both the structure and arrangement of branches and needles contribute to the excellent snow interception abilities of Douglas-fir. This snow interception is important because it reduces snow depth, which allows deer to have significantly greater mobility with less energy cost (Parker et al. 1984). Douglas-fir also sheds twigs and branches as the foliage becomes brittle in the cold of winter (Waterhouse et al. 1991). This Douglas-fir litterfall is an important food source for deer, especially as the snow becomes deeper and rooted forage becomes less available (Waterhouse et al. 1994).

Opening size objective

The optimal size of harvest patches in the group selection silvicultural system designed for mule deer habitat is affected by regeneration requirements and winter ecology of deer. A long-term local research project evaluating group selection opening size and orientation has provided useful insights that have been incorporated into the design of the group selection recommended in this plan (Waterhouse and Eastham 2005).

The regeneration objective is to reforest harvested openings to predominantly Douglas-fir. Douglas-fir seedlings in transition and deep snowpack zones are not highly frost tolerant and require a moderate amount of light for early survival and growth. As compared to lodgepole pine, Douglas-fir is less tolerant of frost but more tolerant of shade. In contrast to the shallow and moderate snowpack zones, Douglas-fir trees in transition and deep snowpack zones are less shade tolerant. This reduced shade tolerance, along with the increased height of mature Douglas-fir in the transition and deep snowpack zones, results in the need for larger opening sizes to adequately regenerate Douglas-fir. While the recommended average harvest opening size for single-tree selection silvicultural systems on mule deer winter range in the shallow and moderate snowpack zones is about 0.05 ha, recommended group selection opening size for transition and deep snowpack zones ranges from 0.1 to 1.0 ha depending on snowpack zone and slope/aspect conditions. Since light input is maximized on steep, south-facing slopes, smaller opening sizes are adequate to meet seedling light requirements on these sites, while larger openings are required on the moderate and cooler aspects. Frost protection for Douglas-fir seedlings can be provided using small harvest openings. The need for frost protection is greatest on depression and flat sites that collect cold air to produce growing-season frost. In summary, light requirements indicate the need for increased opening size while frost protection requirements indicate the need for smaller patches. Therefore, from the regeneration perspective, opening size needs to maintain a balance that is tailored to the slope, aspect, and topographic position of each harvest patch.

Deer in the winter must work to minimize energy expenditure while avoiding predation and finding enough food of adequate quality to slow the inevitable loss of their fat reserves. Since the energy costs for deer to travel in snow are high and rise exponentially with increasing snow depth, it is essential that deer winter habitat should provide a connected matrix of habitat that reduces snow depth. Deer in the winter eat both litterfall (Douglas-fir and lichen) and rooted forage. While litterfall forage is found mostly under mature and older Douglas-fir trees, the heaviest shrub forage is found within openings in the forest canopy. However, under deep snow conditions, the shrub forage within small openings is much more available to deer than the forage in larger openings. This is because much of the forage is located in small openings near the forest edge, where there is still some snow interception. Therefore the size, frequency, and placement of canopy openings affect the energy costs for a deer to move through its habitat and to forage. As snow depth increases, fewer and smaller openings with good snow interception cover between them provide the best habitat matrix.

Opening shape and orientation

Factors to be considered when designing the shape and orientation of openings within a group selection

system include: (1) windthrow risk, (2) travel impediments to deer, (3) predator and hunter sight distance, (4) edge effects on seedling growth, (5) harvesting efficiencies, and (6) future access patterns.

Harvesting can contribute to increased windthrow in the surrounding uncut forest or within a stand of partial cutting such as group selection. The risk is greatest when the trees in the existing stand have a high height-to-diameter ratio. Unsalvaged windthrow can also lead to bark beetle infestations.

However, much can be done to reduce the damaging effects of endemic windthrow in group selection cutblocks. For example, openings oriented with their narrow dimension perpendicular to the direction of prevailing storm winds can be more windfirm. Also, smaller openings (less than two tree-lengths wide) are less prone to windthrow than larger openings that allow more wind-fetch. Sound windthrow assessment and management principles need to be used when designing group selection openings on mule deer winter range (Mitchell 1995).

Deer avoid deeper snow at several scales of habitat selection. They select winter home ranges in relatively low snow areas and then, within these home ranges, select forest stands with lower snow depths as the average snow depth increases. Even within stands on winter ranges, deer select micro-habitats that have shallower snow. Openings created in a group selection system will have snow depths that are deeper than in the surrounding forest. The deeper the snow in these openings, the more the deer will avoid them. To travel within these partially cut stands, deer have two options: (1) they can travel around openings by staying under the canopies of the surrounding trees, or (2) they can cross openings. In typical winter conditions, most openings wider than one tree length are rarely crossed unless there are no other options. Therefore, openings should be designed to allow deer to move through uncut forest, especially in their major directions of movement.

Long sight distances can potentially make predators and human hunters more efficient at taking deer. Long, narrow openings perpendicular to roads can increase sight distances and should therefore be avoided when possible.

Seedling growth is reduced near the edge of openings because of competition for growing resources from the surrounding trees. Research on initial seedling growth has shown that this effect is largely limited to about the first 2 m beyond the drip line on the south aspect (north side) of openings and to about 5 m on the north aspect (south side). Long, narrow openings have a higher percentage of edge, and therefore more potential impacts on seedling growth in the openings, while circular or square openings will have the least impact on growth.

Shelterwood Silviculture System

The shelterwood system is defined as a silvicultural system in which mature trees are removed in a series of cuts to achieve a new even-aged stand under the shelter of remaining trees.

The shelterwood system has two limited applications on winter range. One application is for stands with a very high proportion of non–Douglas-fir trees on sites that may result in frost problems for Douglas-fir regeneration. Given the objective to move these sites to Douglas-fir as quickly as possible, the planted Douglas-fir must be sheltered from frost until it reaches approximately 50–100 cm in height. Regeneration height before shelter cover removal depends on a number of factors including snow depth, regeneration density, and logging method. Leave the mature Douglas-fir and some of the mature non–Douglas-fir to protect the regenerating Douglas-fir from frost.

The other application of the shelterwood system is for cutblocks where the general risk of growing-season frost is low, except on specific micro-sites, such as small depressions where cold air can pool. In this situation, the shelterwood system can be used on individual group selection openings to ensure Douglas-fir regeneration. In most cases, using the recommended opening sizes for group selection should be sufficient to protect planted Douglas-fir from frost. However, it is still possible to have frost problems in the middle of larger openings on frost-prone micro-sites. On these micro-sites, a proportion of the mature cover could be retained in the opening to shelter the young Douglas-fir.

Another option for reforesting Douglas-fir on these small frost-prone micro-sites would be to use "nurse" trees. The nurse tree crop is planted first and allowed to grow for several years before Douglas-fir seedlings paired with each nurse tree are planted. Potential nurse tree species include aspen, birch, or pine.

Thinning-from-below

Thinning-from-below is a form of stand thinning that concentrates harvest on suppressed and intermediate canopy layers that are below the main co-dominant canopy layer. This type of thinning is designed to reduce self-thinning mortality and to concentrate future growth on the larger and more vigorous stems.

Figure A6.2, below, depicts a stand before and after thinning-from-below. In the thinning approach designed for transition and deep snowpack winter range stands, a maximum of 25% of the conifer basal area can be removed, and species other than Douglas-fir are the first priority for removal.

These objectives ensure that the ability of the stand to intercept snow will not be reduced significantly. Also, no Douglas-fir trees > 37.5 cm dbh are to be targeted for harvest.

In group selection systems, especially on cool aspect slopes, most light comes into openings through the canopy of adjacent trees because the sun angle is relatively low. Thinning-from-below, on the south and southwest side of openings, can increase the light available for seedling regeneration in adjacent group selection openings.

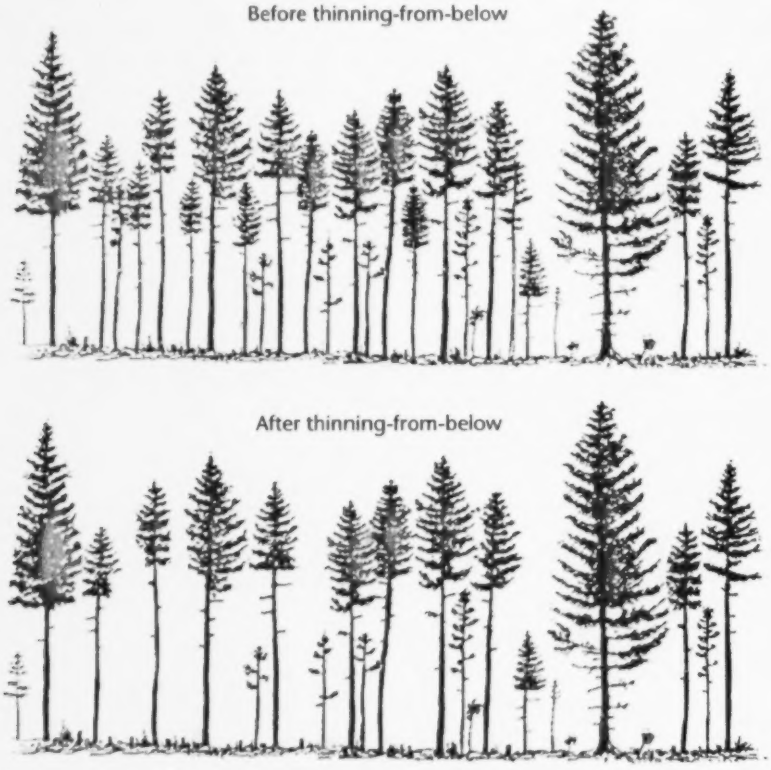


FIGURE A6.2 *Thinning-from-below in Douglas-fir–dominated stands with a dense pole layer.*

Thinning-from-below means that less vigorous trees in the intermediate and suppressed canopy layers should be the first priority for removal. For Type C harvest, only stems up to 37.5 cm dbh are candidates for removal, and a minimum of 75% of the pre-thinning conifer basal area is retained. The figure only shows thinning of commercial stems. The stand could also benefit from spacing of some non-commercial stems. The figure is adapted from *Thinning Systems for Western Oregon Douglas-fir Stands: What's Best for You.* 1993. Oregon State University Extension Service.

A number of forest health issues can affect winter range condition in some way. Prevalent forest health issues found on winter ranges in this region include Douglas-fir beetle, mountain pine beetle, Armillaria root disease, and western spruce budworm.

Douglas-fir beetle

Endemic levels of bark beetle are both inevitable and desirable within a forest ecosystem. The objective of pest management on winter range should be to suppress expansion of beetle populations without limiting the achievement of other objectives (i.e., maintenance of mule deer stand structure objectives, wildlife tree recruitment, old seral representation). The loss of beetle-killed trees, as well as the trees harvested or damaged to access these trees, can have a significant impact on stand structural characteristics required by wintering mule deer and on the management regimes required to maintain or restore deer winter habitat. Removing a significant number of green Douglas-fir trees to access beetle-attacked trees is not recommended on mule deer winter range. Piling and burning or other innovative techniques should be considered when planning beetle control operations on winter ranges. No green Douglas-fir trees should be harvested to salvage beetle-killed trees from which beetles have already flown.

Removing a significant number of green Douglas-fir trees to access beetle-attacked trees is not recommended on mule deer winter range.

Douglas-fir bark beetles are attracted to large-diameter logging slash, including cull pieces resulting from stem rot. When Douglas-fir beetle populations are high, Douglas-fir cull logs, even in short pieces, should be hauled to landings and burned. An alternative treatment to maintain valuable woody debris on site would be to leave these pieces on site and treat them with anti-aggregation pheromones just before the first bark beetle flight in late March to early April to disperse the beetles.

Extra care should be exercised when planning and conducting salvage operations on mule deer winter range. This is particularly true on the winter range areas designated to be managed for old seral attributes. Within Old Growth Management Areas (OGMAs), there should be no salvage of dead trees from which the beetles have already flown. Use of trap trees outside of the OGMA may be a useful management technique. Any bark beetle sanitation treatment that would require felling and removal of trees within the OGMA must be critically reviewed to ensure consistency with the desired long-term condition of the OGMA. The CCLUP *Regional Biodiversity Strategy Update Note #7: Integration of the Biodiversity Strategy with a Douglas-fir Beetle Suppression Strategy: Interim Direction* will provide guidance on Douglas-fir bark beetle management within OGMAs.

Mountain pine beetle

While most of the forested area within winter range is dominated by Douglas-fir, individual stems and even small stands of pine are common on many winter ranges. Many of these areas have been and will continue to be affected by mountain pine beetle (MPB). Removing the pine in order to deal with MPB does not directly have an impact on the suitability of the winter range. However, removing Douglas-fir to build skid trails and landings, and to access pine, will have an immediate impact on winter range suitability.

To minimize the negative impact on mule deer winter range, the guidance in the following box should be followed.

When Mountain Pine Beetle Attack Occurs on Mule Deer Winter Range

- If the basal area of mature pine in the stand is low (20% or less), it should be a low priority for harvest.
- Where possible, especially when pine is less than 40% of the basal area, harvest of pine should be accomplished through a well-planned group selection that meets the objectives for Harvest Opportunity Type D. This may mean that small isolated areas of pine may remain unharvested.
- If the attack is not current (i.e., the beetles have flown), salvage of beetle-killed pine should be a low priority, especially in stands with a small amount of pine (20% or less).

If beetle-infested pine is harvested without using group selection, it must be done within a cutblock designed to meet the objectives for Harvest Opportunity Type B.

These objectives include the following:

- Harvest or damage to Douglas-fir must not exceed 15% for stems 22.5–37.5 cm dbh and 5% for stems > 37.5 cm dbh (including skid trail development) of the pre-harvest basal area of Douglas-fir stems in each of these two diameter class groupings.
- Minimize the area covered by skid trails.
- Regenerate to Douglas-fir wherever ecologically possible.

Western spruce budworm

Over the past few years, western spruce budworm has moved north to attack Douglas-fir forests in some mule deer winter range areas of the Cariboo-Chilcotin. This insect is more of a potential problem in the shallow and moderate snowpack zones than in the transition and deep snowpack zones. The following quotes are from a Master's thesis that addressed selection management on mule deer winter range on the UBC Research Forest's Knife Creek block in the moderate snowpack zone. For references to relevant literature, please refer to Day (1998).

> "A relationship between tree vigour, stand density and damage to Douglas-fir has been demonstrated for western spruce budworm. As the vigour of the tree declines, its ability to recover foliage biomass suffers. Budworm defoliation is also intensified by multi-layered stand structures. Spruce budworm damage is sensitive to stand structure since the dispersing larvae must land on host material to continue maturation feeding. Well developed vertical structure provides more hosts in subordinate positions for dispersing larvae."

Day was seeking ways to achieve mule deer/stand structure objectives recommended by the *Mule Deer Handbook*, and reconciles the recommended practices with the literature on western spruce budworm as follows:

> "This plan (for Knife Creek Mule Deer Winter Range) advocates single-tree selection management for Douglas-fir, which is contra-indicated by the previous discussion. However, due to the silvics of Douglas-fir at Knife Creek, stand structure will be horizontally diverse, since gaps of up to one tree length will be created for regeneration. Small trees will not be arranged directly below larger trees. Repeated entries will thin all layers of the stand, and thus maintain tree vigour. Managing the stands in that fashion should help reduce damage by budworm in the event of an outbreak."

The biological insecticide Btk (*Bacillus thuringiensis* var. *kurstaki*) has been used to manage western spruce budworm in the region. Mule deer winter ranges, especially those along the Fraser and Chilcotin Rivers, incorporate provisions for red- and blue-listed species, including various bat species and flammulated owls. These species depend on *Lepidoptera* (moths and butterflies) for food and could therefore be adversely affected by Btk. If Btk is sprayed on these mule deer winter ranges, we recommend that: (1) only those areas of the winter range that are significantly infested with budworm be sprayed, (2) a maximum of one-half of the winter range be sprayed in any one year, (3) the grassland benchmark area not be sprayed, and (4) the forest within 1 km of the forest/grassland interface should be a low priority for spraying.

Armillaria root disease

Armillaria root disease is present on some transition and deep snowpack mule deer winter range stands. Active research and development of new integrated approaches to dealing with this disease are being developed in the Cariboo-Chilcotin (Chapman et al. 2004). The integrated approach currently being developed by Bill Chapman and Bruce Shellenburg recommends a suite of measures that will work together to reduce the damage from Armillaria.

Armillaria control measures that are compatible with the group selection approach used on transition and deep snowpack winter ranges include the following[1]:

1. Maintaining mature trees in infection centres that have survived Armillaria as seed sources for regeneration.
2. Using natural regeneration to take advantage of the evolved resistance of local trees to the local strains of Armillaria and to avoid the increased susceptibility of container stock to Armillaria root disease.
3. Minimizing soil disturbance that can provide a substrate for increased colonization by new Armillaria genets.
4. Maintaining coarse woody debris of all size classes from fine to coarse within group selection openings to provide nutrient sources for desirable fungi that compete with Armillaria. Debris should be spread evenly or left in small clumps.
5. Using *Hypholoma faciculare* inoculation to enhance populations of desirable fungal species that strongly compete with Armillaria root disease. Consider spot application as infection centres become apparent.
6. Carefully identifying infections centres and considering leaving them unlogged as wildlife tree patches (WTP). Also, consider ringing Armillaria WTP with logged areas to create root gaps so that Armillaria spread into the stand by root contact is reduced. Treat logged rings using a combination of as many as possible of other mitigating treatments outlined here, to reduce the risk of Armillaria flashing in the logged rings.
7. Using alternative species to break up root-to-root contact of Douglas-fir, where inclusion of some species other than Douglas-fir is acceptable. For example, plant cutover rings, described in Point 6, with deciduous species.
8. Grooving stump tops to collect moisture to speed up decomposition of stumps. Apply nitrogen fertilizer to stump tops to speed up decomposition of stumps.
9. Looking at potassium nutrient status and, where applicable, considering potassium fertilization.

1 B. Chapman, B.C. Ministry of Forests and Range, Williams Lake, B.C., pers. comm.

Armleder, H.M. and R.J. Dawson. 1992. Logging on mule deer winter range: An integrated management approach. For. Chron. 68:132–7.

Armleder, H.M., R.J. Dawson, and R.N. Thomson. 1986. Handbook for timber and mule deer management co-ordination on winter ranges in the Cariboo Forest Region. B.C. Min. For., Res. Br., Victoria, B.C. Land Manage. Handb. 13. <http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh13.htm>

British Columbia Ministry of Forests. 1995. Silviculture Systems Guidebook, 1995. Forest Practices Code. B.C. Ministry of Forests, Victoria, B.C.

Cariboo-Chilcotin Land Use Plan (CCLUP). 2004. Procedures for implementation of the mountain pine beetle–biodiversity strategy to address current attack during the outbreak phase. Regional Biodiversity Conservation Strategy Update Note #6 – June 2004. Available at <http://srmwww.gov.bc.ca/car/planning/cclup/biodiv/biodiv6.pdf>**

———.2005a. Integration of the biodiversity strategy with a Douglas-fir beetle suppression strategy: interim direction. Regional Biodiversity Conservation Strategy Update Note #7 – December 2005. Available at <http://srmwww.gov.bc.ca/car/planning/cclup/biodiv/biodiv7.pdf>**

———.2005b. Integration of the biodiversity strategy with a spruce bark beetle suppression strategy: interim direction. Regional Biodiversity Conservation Strategy Update Note #13 – December 2005. Available at <http://srmwww.gov.bc.ca/car/planning/cclup/biodiv/biodiv13.pdf>**

Chapman, B., G. Xiao, and S. Myers. 2004. Early results from field trials using *Hypholoma fasciculare* to reduce *Armillaria ostoyae* disease. Can. J. Bot. 82:962–9.

Day, J.K. 1998. Selection management of interior Douglas-fir for mule deer winter range. MF thesis. Faculty of Forestry, Univ. British Columbia, Vancouver, B.C.

Mitchell, S.J. 1995. The windthrow triangle: A relative windthrow hazard assessment procedure for forest managers. For. Chron. 71:446–50.

Parker, K.L., C.T. Robbins, and T.A. Hanley. 1984. Energy expenditures for locomotion by mule deer and elk. J. Wildl. Manage. 48:474–88.

Steen, O.A.S., R. Stathers, and R. Coupé. 1990. Identification and management of summer frost prone sites in the Cariboo Forest Region. For. Can. and B.C. Min. For., Victoria, B.C. FRDA Rep. 157. <http://www.for.gov.bc.ca/hfd/pubs/Docs/Frr/Frr157.htm>

Waterhouse, M.J., H.M. Armleder, and R.J. Dawson. 1991. Forage litterfall in Douglas-fir forests in the central interior of British Columbia. B.C. Min. For., Res. Br., Victoria, B.C. Res. Note. 108. <http://www.for.gov.bc.ca/hfd/pubs/Docs/Mr/Rn108.htm>

———. 1994. Winter food habits of mule deer in the central interior of British Columbia. B.C. Min. For., Res. Br., Victoria, B.C. Res. Note 113. <http://www.for.gov.bc.ca/hfd/pubs/Docs/Mr/Rn113.htm>

Waterhouse, M.J. and A. Eastham. 2005. Assessment of silviculture systems developed for deep snowpack, mule deer winter range in the central interior of British Columbia – regeneration and vegetation components. B.C. Min. For., Res. Br., Victoria, B.C. Tech. Rep. 021. <http://www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr021.htm>

** If this URL, current as of January 2006, is not active, or does not redirect, please see <http://www.for.gov.bc.ca/hfd/library/RBCS.htm>.